# Knowledge & Scientific News

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**Conducted by MAJOR B. BADEN-POWELL, F.R.A.S., F.R.Met.S., and E. S. GREW, M.A.**

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## Factors of Organic Evolution.

*(Concluded.)*

III.

By W. P. PYCRAFT.

IN the December issue of "KNOWLEDGE" I endeavoured to show that the study of organisms as a whole, in relation to their environment, will not, as some suppose, afford us the key to the Factors of Evolution. It is assumed by many that all characters whatsoever are the product of Natural Selection, though certain exceptions are made in the case of characters which are said to be due to what is known as "the 'law' of correlated variation." Hence the unsatisfactory character of all explanations which seek to account for the minute differences which distinguish nearly-related species. It is, we contend, a mistake to suppose that all characters have a significance in the well-being of their possessor. The vexed questions as to the part played by "Continuous" or "Discontinuous" variation, and the usefulness or otherwise of "minimal increments" in the "struggle for existence" will never be solved till these assumptions are set aside.

The variability which living bodies display is a necessary consequence of the instability of their constituent protoplasm. And we are apt to miss the true significance of the range of this variability as displayed in individuals. Continuous variations may in many cases, and perhaps in all, represent "discontinuous variations" "slowed down."

Furthermore, in studying any given animal as a whole, in relation to its environment, we are all of us prone to discover a fairly exact adjustment between it and the external environment. Yet a little reflection will show that this adjustment is often by no means so close as ap pears to be the case; and thereby, for the moment, the difficulty of solution of our problem is increased rather than diminished.

The phenomena of adaptation to peculiar modes of life are among the most convincing forms of evidence of the action of Natural Selection. Many instances of such adaptation I have already given, and as many more will occur to my readers. No more striking case, perhaps, can be found than that furnished by the Accipitres and Owls, by the older ornithologists designated Diurnal and Nocturnal Birds of Prey, because they were regarded as nearly related types; it is now known that they are not even remotely related. In the matter of beak and claw they are practically identical; yet the Owls are highly specialized descendants of the stock which gave rise to the Nightjars!

In the matter of the skeleton the resemblance between the Accipitres and the Owls is no less striking, and this, of course, is attributable to their mode of life—the capture of living and swiftly-moving prey. One would have supposed that this likeness would have been still preserved in the structural details of the intestines called upon to assimilate that prey. Yet such is by no means the case. In the nature of their convolutions, as Dr. Chalmers Mitchell has shown, in his brilliant essay, these two groups of birds differ as widely as can be. But more than this—the paired cæca in the Accipitres are vestigial, in the Owls of great size and peculiar shape (fig. 1).

If cæca are not needed in the economy of the Accipitres why should they persist in the Owls? The cæca of the Owls, it must be remarked, in their relative size and shape recall those of the Nightjars—the allies of the Owls—which feed mainly on insects. The Short-eared Owl, I may be reminded, still commonly feeds on insects;

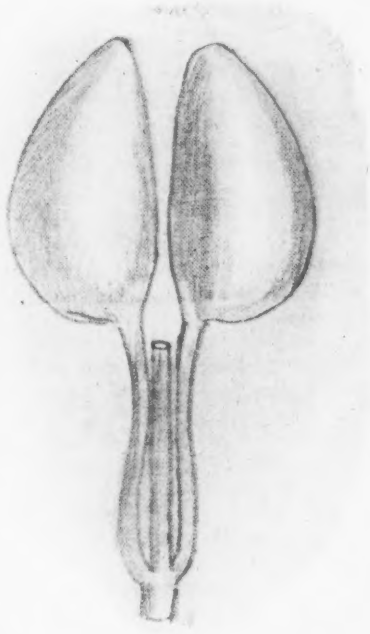

**Fig. 1.—Cæca of an Owl. (After Beddard.)**

this is certainly true, for I have myself examined the gizzard of one of the birds which was crammed with dor-beetles (*Geotrupes*). But the cæca cannot have been retained for this purpose, since some of the tiny falconets, which are Accipitrine birds, feed exclusively on insects, and the Hobby among the true Falcons almost entirely. Yet in these birds the cæca are vestigial! Among the Nightjars, as we have remarked, the cæca are large; yet in one genus (*Ægotheles*) they are absent, though there is no evidence that the species of the genus differ in the matter of food from the rest of the order. Here there is an organ which seems to bear no relation to the kind of food which is passed through the intestines. Where it retains any considerable size we must assume

that it *is* functional, though that function has yet to be discovered. Our point is that it bears no such appreciable, no such direct, relation to the nature of the food as one would have supposed, if the contradictory elements had been eliminated. Many external characters seem to stand in the same relation in regard to the requirements of the external environment. They are regarded as so many expression points of the struggle for existence; and while some are accounted vestiges, fading records of past phases of evolution, others are supposed to be still of vital importance, yet we suspect many of these neither play, nor have played, any such part. Some may be correlated characters which were not injurious to well being, others are rather to be regarded as potential elements, which, by their further development, will sooner or later either materially benefit or injure their possessor in the struggle for existence, when they will either carry evolution by reason of the fact that the organism as a whole is thrown out of gear with its environment.

The early post-embryonic stages in the development of the skull of the bird afford valuable data in support of this—valuable because the facts in question can have no conceivable influence in the "struggle for existence" and therefore cannot be modified thereby. We allude to the relative size and portion of certain of the membrane bones of the skull, wherein the sections commonly close before the bird has left the nest.

First of all as to cranial characters. I do not propose to enter into the details of these but to take samples therefrom. The squamosal, for example, was originally, as in the reptiles, a scale of bone attached to a flying buttress, or spur projecting backwards and outwards, from the hinder border of the parietal. Later, as this spur shortened the squamosal was brought nearer to the cranial wall, and ultimately became applied to its outer surface forming a

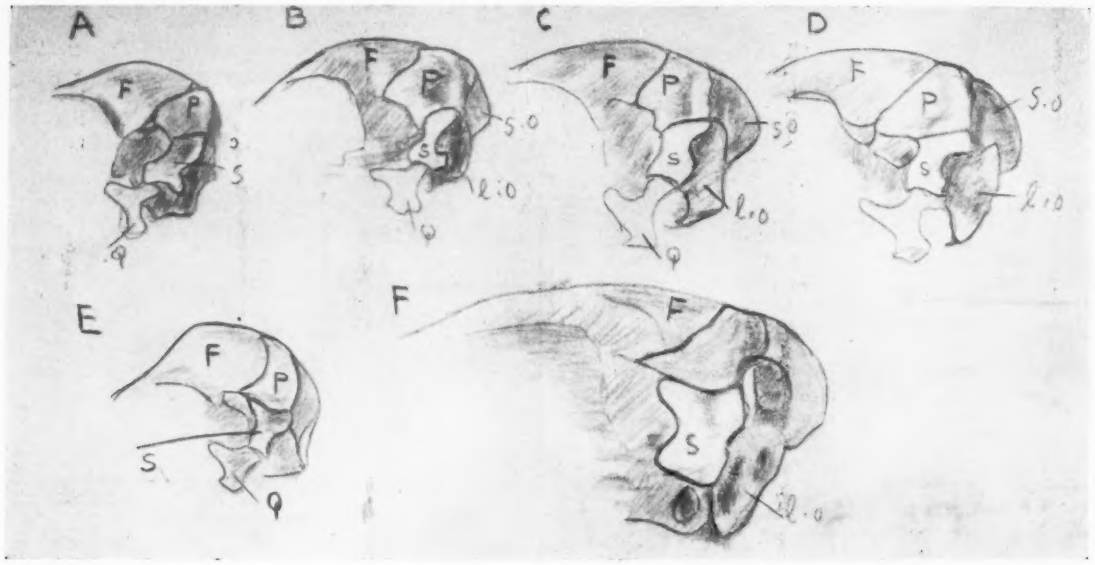


**Fig. 2.—Lateral aspect of crania of Penguins to show evolutionary stages of the squamosal.**

A. *Catarrhactes*. B. Spheniscus. C. *Pygoscelis adeliæ*. D. *Pygoscelis papua*. E. Ripe embryo *Aptenodytes*. F. ¾ grown young.
S. = Squamosal. P. = Parietal. F. = Frontal. S.o. = Supra-occipital. l.o. = Lateral occipital.

a stage further, or bring about the extinction of the organism.

While we very properly regard the Giraffe and the Whale, the bird and the butterfly, as so many products of evolution, fashioned, as most of us believe, by the hammer of Natural Selection, in effect we regard these several types as so much homogeneous malleable matter, even when we realise that the several parts of these several types are "adapted" to perform their particular duties. That is to say, that this or that organ was not "made" for its particular purpose, but has been modified or changed, developed, by a process of transformation: the paddle of the Penguin and the Whale, the wing of the Bat, the bird, and the Pterodactyle, from so many varied types of ambulatorial limbs. We must dig deeper to discover what we seek; or to put it more correctly we must analyse more carefully. And this analytical work will soon give more definite shape to what is already vaguely perceived, to wit, that there is an undercurrent of evolution which is never apparent, never expressed, in externals, is free to pursue its own course unless, and until, checked

sutural connection with the parietal. It may be studied in its most primitive condition in the Penguins and Struthious birds. In the former it is still, during early stages of development, only a plate of bone readily detachable from the skull (fig. 2, D). Later it entered into sutural relations with the frontal and exoccipital, and at the same time began to absorb the underlying bone, till now, in many species, the greater part of its inner surface is directly applied to the brain. Here, then, we have the early history of the avian squamosal. If we now regard this bone as an entity, and if we proceeded to trace its descent as though it were a "species" related nearly and remotely to other "species" of squamosal, we should find that it had amost interesting evolutionary history, but one which has, so far as we can see, no relation to external factors such as mould the organism of which it forms a part.

In the penguins of the genus Pygoscelis this bone is attached only by its dorsal border to the parietal; it is oblong in form and has the posterior border deeply excised; furthermore it differs in shape in different species of Pygoscelis (fig. 2, C D). In the genus *Catarrhactes*

(A) it tends to become more elongated, and this tendency is still more marked in *Spheniscus* (B). In *Aptenodytes* (E F), on the other hand, the anterior border is the more excised, while the posterior border has formed attachments with the supra and lateral occipital.

As we pass to other more specialised groups of birds we find this squamosal shifting forwards, so as to extend along the whole outer lateral border of the parietal instead of being attached to the external posterior angle thereof, and this movement is continued until it comes to lie along the lateral borders both of the parietal and frontal,

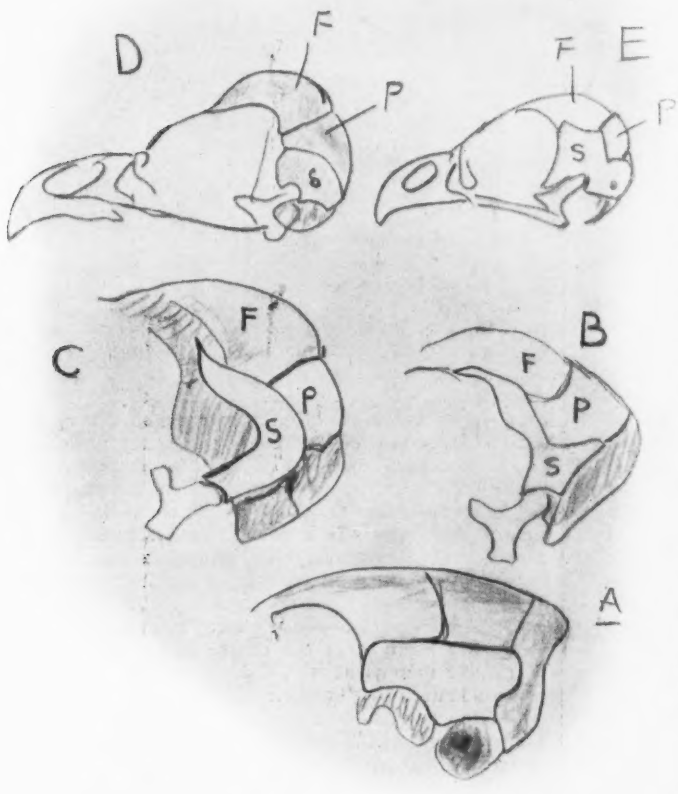


**Fig. 3.—Further phases in the history of the squamosal.**

A. Skull of common fowl. B. Skull of Gull. C. Skull of Petrel. D. Skull of tawny owl. E. Skull of burrowing owl
S = Squamosal. P. = Parietal. F. = Frontal.

as in the fowl, wherein it has attained a relatively enormous increase in size (fig. 3, A). As the skull as a whole changes shape, and assumes a more spherical form the squamosal also changes, now assuming a blade-like shape as in the gulls (B); in the petrels it undergoes a yet further change, becoming boomerang-shaped, with its anterior horn projecting as a free spur, laterad of the skull. The owls furnish yet further evolutionary phases (fig. 3, D E). In the tawny owl this bone, oval in shape, occupies what we may call its normal position—the parietal border; and is separated from the frontal by the overlapping moiety of the parietal (fig. 3, D); but in the burrowing owl (*Speotyto*) the squamosal is relatively of huge size and rises upwards to form a broad surface of attachment with the frontal, truncating the lateral wing of the parietal in so doing (fig. 3, E).

Now it cannot be contended that these idiosyncrasies of growth presented by the squamosal are of any importance in the struggle for existence in these various types of birds. The number of illustrations of this kind might be immensely increased, but enough have been given to serve my purpose, which is to suggest that this bone—any other bone of the skull, or trunk, would have done as well—displays the same evidence of germinal variation as is to be seen when the sum of all the parts is reviewed—the organism which we call an owl or a penguin, as the case may be, and, further, that these variations, once started, display a greater or less amount of "vitality," a potentiality to go off in this or that new direction, checked only by the nature of its surroundings. In the organism as a whole the brake is applied by the environment, if need arises; in the several parts of the organism the struggle is between neighbouring parts. Where one bone increases so as to overlap another, in course of time the overlapped region is absorbed by the overlapping. The struggle is intraorganismal.

In the varied fluctuations of growth which any given structure presents, as in the case of the squamosal, Peter is robbed to pay Paul; there is no loss of energy, so to speak. One part of an organ does not go off at a tangent and so disrupt the whole, but excess in one region is accompanied by reduction in another. Contiguous parts affect one another, as was shown in the case of the inflation of the area of bone impinging on the median portion of the cancellated tissue forming the casque of the cassowary, and of the formation of new articular surfaces for ribs which have lost their connection with the sternum, discussed in the December number of "KNOWLEDGE." The case of the casque of the cassowary is peculiarly interesting and is so far inexplicable. It is of a kind exactly the reverse of cases where an overlapping bone brings about the absorption of the areas overlapped; it is a case, so to speak, of "infection"—but how is it brought about?

The idiosyncrasies of growth herein described are characters reproduced in each species as regularly as the spots and stripes of the plumage, markings which are commonly attributed to the action of the external environment. As a matter of fact, such markings are probably merely expression points of instability, though by exaggeration in this or that direction they may eventually bring the creatures so marked under the winnowing fans of selection.

But the really surprising part of this matter is the stability of this "instability." For if a thousand individuals be examined, either in regard to any given external, or any particular internal, character, the range of variation will generally be found very slight. But this only seems to support the view that variations are due to germinal permutations and combinations, which once started in any given direction go on increasing like ripples caused by a stone thrown into the water.

One very important feature in this evolutionary process, however, is yet to be noted, and that is the fact that external are much more given to variation than internal

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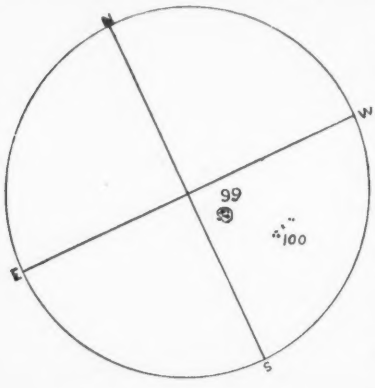
characters. In some animals these external characters change periodically, as among birds which display seasonal changes of plumage; and, besides, we have sexual changes, and more or fewer liveries peculiar to immature stages of development. It would seem that the peripheral parts vary most; but even here, after passing through a phase of great changefulness, as when seasonal, sexual, and immature plumages are all exhibited in the same individuals, there comes a period of rest; and this when the individuals of both sexes and all ages come again to wear the same livery—this time the livery first perfected by the male, then acquired by the female, and finally by the young, as in the parrots. But this opens up another aspect of our subject which must be left, with the Editor's permission, for another occasion.

## The Great Magnetic Storm of September 25th.

After the paper which appeared in our December number was in type we were favoured by M. Deslandres, of the Physical Observatory at Meudon, with four spectroheliograms taken in the red light of hydrogen = C, or $H_\alpha$.

No. 1, 1909, September 24, 16h. 28m. to 16h. 45m.—Shows the upper layer of hydrogen, obtained by the large spectroheliograph with three slits. The more central spot (No. 99 of our monthly list) is surrounded by nearly concentric filaments. The principal detail is the beautiful filament of the south-east, which disappeared the following day. The accompanying diagram of the sun on this date will help the identification of the groups.



THE SUN, 1909, SEP 24

No. 2, September 25, 8h. 31m to 8h. 45m.—Shows the mean level of hydrogen, obtained with the same apparatus. This image is taken at about the same level as the American photographs. No similar plate was taken on the previous day.

No. 3, on same date, 8h. 11m. to 8h. 26m.—This photograph shows the lower level of hydrogen, taken with the same apparatus. In this the bright edging of the spots is quite lost. No corresponding plate was taken on 24th.

No. 4, on same date, 8h. 53m. to 9h. 11m.—This corresponds with No. 1, and shows the upper level of hydrogen. Great change appears in the southern hemisphere. The great filament of the south-east and another smaller one have disappeared, and the curving filaments around the spot—99—have been modified.

The original photographs were 40 mm. in diameter. The upper level photographs, 1 and 4, are taken with the light from the centre of the C-line, and the lower level, 3, with that from the outer part of the line, the mean level being taken with the light between that employed for the others. The original photographs of Nos. 1, 2, and 4 show prominences faintly on the eastern limb or edge.

## Red Deer in the Highlands.

By ALEX. INKSON MCCONNOCHIE.

RED deer (*Cervus elaphus*) are to be found in each of the three great divisions of the United Kingdom, but the Highlands of Scotland are now their special reserve in the British Islands. There they may be seen in immense numbers, no fewer than three and a half million acres being set apart as deer forests. Only a negligible portion of that great tract is suitable for cultivation, the deer being restricted as a rule to upland glens and moors in the mountainous districts of the north and west, where rock and heather abound. Needless to say, sport is responsible for them surviving in such herds in Scotland.

The chase of the red deer was always the sport of kings and the great landowners, and so poachers were severely dealt with from the earliest times. There is abundant evidence that such hunting was a well-established sport long before William I. of England or William the Lion of Scotland asserted their sovereign rights. The Scandinavian historian, Torfœus, refers to deer hunting in the Highlands of Scotland as early as the twelfth century, but centuries before him there were permanent records of the national sport of the country. The sculptured stones of the second class (*i.e.*, A.D. 800-1000) abound in representations of deer hunts, nor are the stones of the first class (*i.e.*, previous to 800) altogether without reference to deer. Among the former may be mentioned a Ross-shire example which shows three men on horseback with a hound after a stag; also a man kneeling and shooting with a bow at a deer. Another stone in the same county has a remarkable hunting scene—a woman on horseback, two men on horseback with spears and shields, two men blowing horns, and a stag pursued by two dogs. One of the dogs seems to have hold of the stag by the tail, while the other hangs on to the shoulder. Forfarshire is particularly rich in sculptured stones depicting deer hunts. The most noted represents four men on horseback and three on foot (two of the latter with horns), and there are three stags and three hounds.

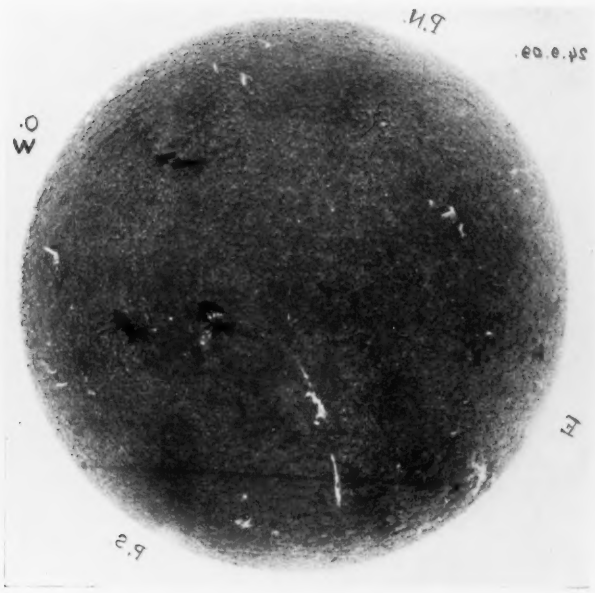
The conditions of life have altered as much for deer as they have for men in the course of time. In earlier years deer roamed at will, and even when the country was gradually being brought under the plough they were not quite excluded from the crops. As a natural consequence "fat bucks" were frequently met with, and great antlers often adorned the stags. Deer are more numerous now than then in Scotland, but their feeding grounds are much restricted, and so, as might be expected, they have, as a rule, fallen off both in weight and horn. The antlers occasionally found in peat mosses are not equalled by the "heads" of to-day, but, on the other hand, fairly good heads are doubtless more numerous now than they were in "the good old times." A "warrantable" stag requires a considerable area; on an average 500 acres may be roughly held as necessary, but the extent varies with the quality of the pasture and the winter shelter. When a treeless deer forest is fenced off from the low ground the conditions are altogether unnatural in a long-continued snow-fall, and so artificial feeding may become necessary. The death roll to-day from simple starvation may well be compared with the fatalities when wolves looked upon deer as their natural prey.

The male red deer is known as the stag, the female as the hind, the young as the fawn or calf. The old sporting names for stags according to age and number of points on their antlers, for which we were indebted to France, have given place to such terms as, say, five-year-olds and ten-pointers. With twelve points to his

# The Great Magnetic Storm of September 25th.

**Spectroheliograms taken in the light of red hydrogen = C, or $H_\alpha$.**

*(Negative Reproductions.)*



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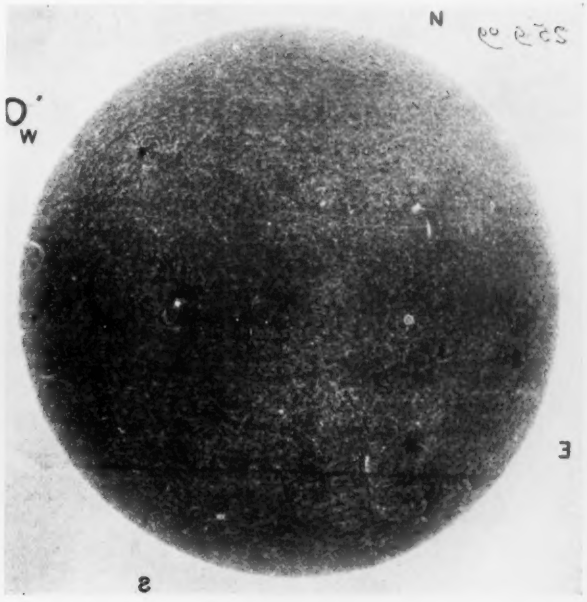

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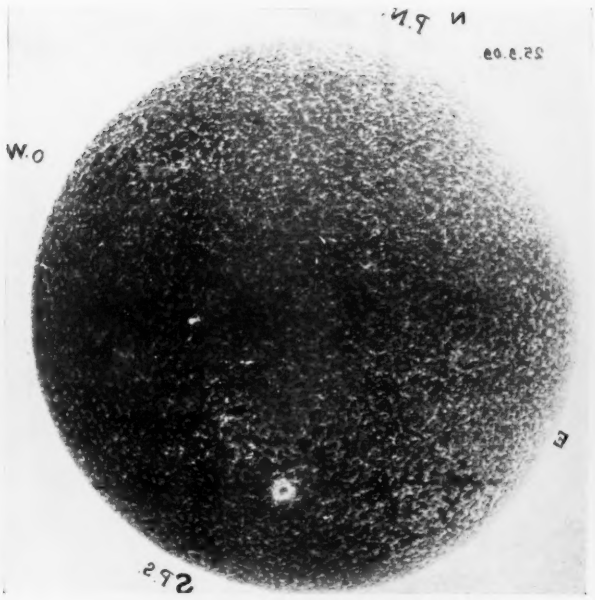

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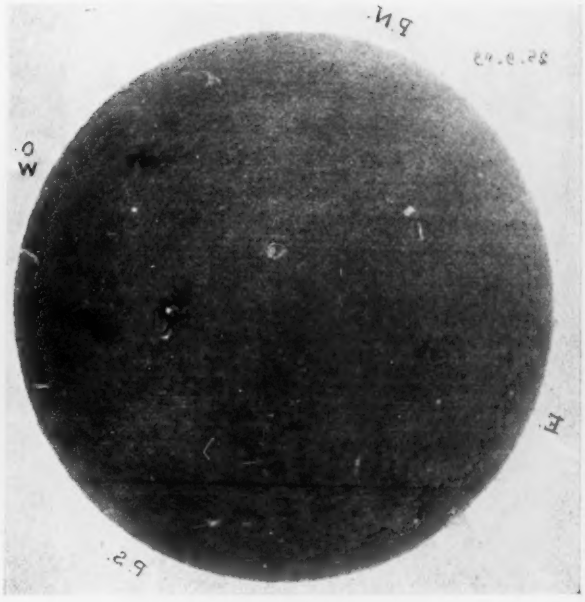

No. 4.

*Photos by M. Deslandres, of the Physical Observatory at Meudon.*]

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antlers a stag is now generally called a Royal, with fourteen an Imperial; but these names are very modern. The stag is certainly a most peculiar animal, being condemned by Nature to a comparatively retired life for

**A three-horned stag.**

nearly a third of the year. The horns are shed annually in spring, and not till autumn does the stalker think him worthy of attention. Fawns are dropped in June; September and October are the rutting months. It has to be remembered that the casting of the horns, the birth of the calves, and the mating season have a certain dependence on the weather, and also vary somewhat according to the situation of the forest.

The higher the forest is above sea level the longer the stags are in casting their horns, and the younger are later than their seniors. With a severe winter the shedding may be delayed a week or even ten days; in wet seasons the horns fall more readily, in frost less. But all will probably have dropped off by the first week of May. The 6th of March may be regarded as the earliest noted date, while stags have been seen with their old antlers even in June, but March and April are considered the usual months for shedding. Instances have been observed of particular stags casting their horns twice in the same year—second castings taking place in November and December. In such cases, however, the new winter horns are much short of the standard. Castrated deer do not shed their horns; if gelded when the antlers are fully developed they remain unaltered till death. In like manner, if gelded as a calf, or when the horns have just been cast, the stag will remain "hummel." Such deer, "heaviers" as they are sometimes called, are extremely shy, and as a rule herd together, especially in the rutting season.

When the time comes for parting with his horns, the stag is evidently ill at ease. His head moves from side to side, and he seems stunned, not apparently knowing what to do with himself. Both horns seldom fall off simultaneously—there may even be three weeks' difference in the dates. The loosening of the horns appears to be caused by chemical action; the mineral substance which connects the antler with the coronet gradually decays till the mere weight of the horns causes them to fall off. Sometimes the horns bleed a good deal at the coronet, but more often only a few drops of blood are seen.

It was long a mystery what became of the fallen horns—the stags were even believed to hide them, and the fairies were popularly supposed to have a hand in their disappearance. The hiding myth is easily accounted for—naturally the horns are often shed among the heather where there is not much chance of their being seen. The deer themselves dispose of many of the horns, the stags often proceeding to eat them as they fall, while hinds are on the outlook for such dainty morsels, whether cast or on dead stags. A hind has been watched gnawing at the antlers on a stag as the pair rested together, and a stag has been observed so engaged on a companion's head. The cravings of deer for such an addition to their food can be easily understood from the habits of other animals.

Generally a fortnight elapses before the new horns are apparent, and about four months pass before the growth is complete and the covering "velvet" disappears. Some stags have been seen "clean" in

**A young fawn.**

July, others have delayed the shredding of the "velvet" till October. During this annual growth, which must be a great drain on the animal, the horns are very soft and so the stags then seek no adventures. The

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substance of which the horns are mainly composed is brought to them by large arteries which are constricted as it is deposited. Finally, when the horns are fully formed the pressure of the enlarging coronet closes the blood vessels and leads to the drying up of the "velvet," which is afterwards rubbed off by the stag, the shredding coinciding with the complete hardening of the antlers. Naturally malformations of antlers are common and occasionally three-horned heads are found. It is noteworthy that generally the stag reflects a wound on the *opposite* horn.

The age of a stag cannot be accurately determined from the number of points, though the ancient belief was that a tine was yearly added to each antler. Horns make little show till the stag is about a year old. Feeding and breeding, age, winter shelter, and ground have each a share in the production of good "heads"; a ten-pointer of some forests is often a more handsome trophy than a Royal of others. Length, span, thickness, roughness, and colour, as well as a certain regularity are considered elements of a "head" worthy of a sportsman's ambition. A three-year-old stag has been observed with twelve points and a five-year-old with fourteen, but such instances are, of course, exceptional. After the stag has reached maturity the antlers become white and light and lose much of their roughness, the points also being then fewer, shorter, and less sharp.

There is a vague impression that stags live longer than hinds. An old Gaelic tradition gives a patriarchal age to deer:

Thrice the age of a dog is that of a horse;
Thrice the age of a horse is that of a man;
Thrice the age of a man is that of a deer;
Thrice the age of a deer is that of an eagle;
Thrice the age of an eagle is that of an oak.

"The New London Dispensatory" (1676) is even more generous—"Living, some say, about a thousand years." Highlanders quote cases of deer "in the olden times" being reputed as "upwards of one hundred years" and "about two hundred years" old, but intelligent foresters now state thirty years as the extreme limit, adding that even few reach that age. The stag is said to be at his best from eight to ten, though some hold that maturity is reached even at seven—but all depends on environment. While a few foresters maintain ten years as the limit to which heads will improve, others say twelve to fifteen.

While June is "the month of fawns," there are many instances both of earlier and later births, but such abnormalities have little chance of survival. Fawns are very weak at birth, sleeping and resting the most of their time for the first few days of their lives, while the mother-hind seeks milk-producing food at some distance. There is a popular belief that hinds always hide their young after giving them suck during the first week. The present writer has more than once come on week-old fawns enjoying a siesta on a pony path. At the tender age of the first few days they have not learned to distrust man; they will even suck the passing tourist's fingers, and he may have difficulty in getting rid of their company. When the fawn is dropped on the heather its colour so harmonises with its surroundings that it is practically invisible at a short distance. The light spots on the skin aid in the concealment and so have been regarded by some naturalists as protective, for after a few weeks, when the little youngsters can hold their own, they quite disappear.

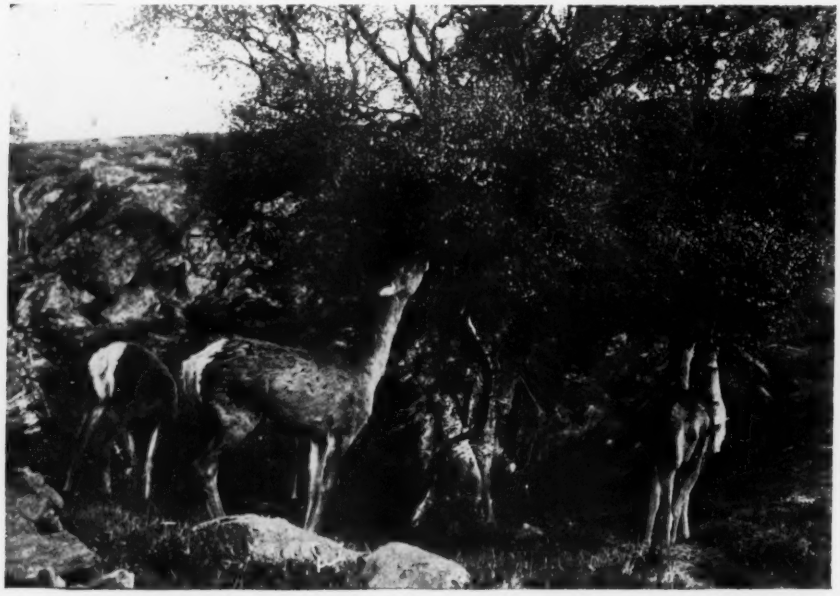
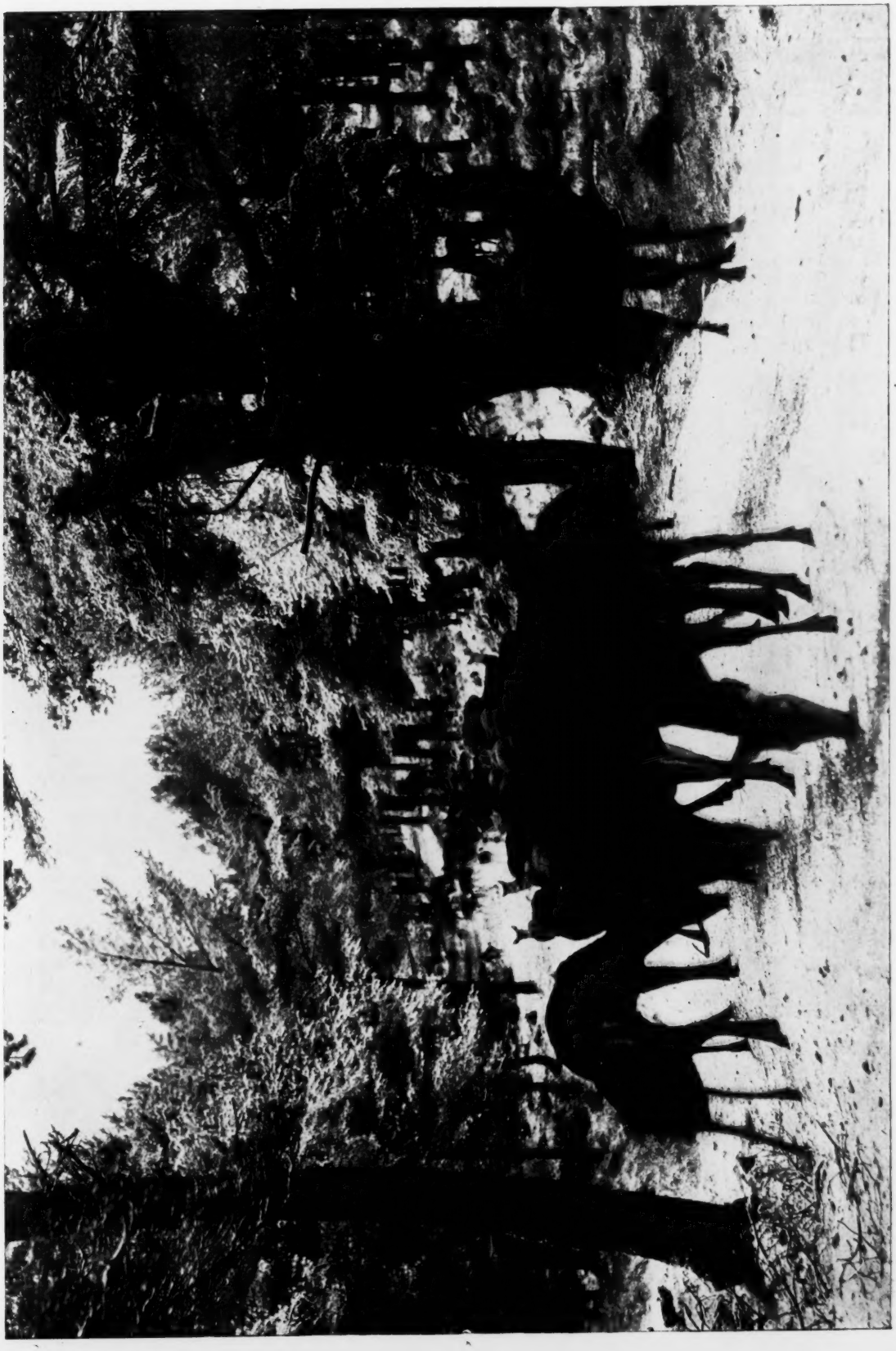


*Photo.*] [*Porter, Aberdeen.*

**Red deer eating treeleaves.**

A visit to a deer forest in June reveals not a little of the home life of deer. A solitary hind brought under observation by the telescope requires some judgment to determine whether she has calved, and, if so, where the unseen fawn is lying. With the naked eye not a beast may be seen; with the glass the hill slopes are observed to swarm with life. To the left is a herd of about sixty hinds—not much use troubling with them for possible fawns, for hinds do not drop their calves in company nor do they seek much society during the first few days thereafter. A little parcel of three hinds gives some promise, for while two of them disappear over the sky line the third slowly proceeds downwards in another direction. Her movements are so deliberate that the conclusion is irresistible that she has a fawn near by—and there it is by the burn-side, its eyes wide open, but pretending not to see us. In another part of the glen a hind could be seen whose leisurely steps suggested family cares. Presently she thrust her nose into the heather, when up started a fawn to which she gave suck. Then the youngster fell behind, selecting a couch for itself while the mother passed on to fresh pastures. When we came up on the tiny deer it was evidently only a day old and so permitted any liberty. Afar off the hind anxiously watched the scene, and, as we went down the glen, quickly rejoined her calf, doubtless much relieved to find that no ill had befallen it. Foxes

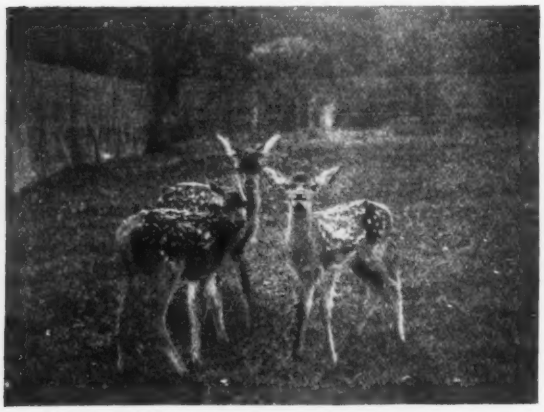


[*Photo*] [*White, Inverness.*

**Deer at Rosehall, Sutherland.**

and eagles are the great enemies of young fawns; it is very interesting to watch how boldly the hinds come to the rescue, and as painful to see their grief when they have arrived too late. Macgillivray, no mean authority, states that only one hind in a hundred will drop twins, but very probably one in a thousand is nearer the truth. A hind giving suck to two calves is no evidence *per se*, for hinds have been known to adopt a motherless fawn.

The rutting season, according to another old Gaelic saying, commences on September 20, that day being known as "the day of the roaring." Roaring, however, has been heard as early as August 18, and as late as December 29. Heard for the first time, stag answering stag, as one walks through a glen after nightfall, the sound has a weirdness that can never be forgotten. It is difficult to satisfactorily explain roaring; it is generally regarded as a challenge, a signal of victory, or an expression of rivalry. Hinds have been observed to take no notice of it, feeding the while as though unaware of the vicinity of their lords and masters. Stags return to the same corrie year after year for hinds; a big harem seems a



**Young fawns.**

point of honour—even 300 hinds have been seen temporarily herded together by a master stag. Desertions, however, are numerous, and envious young stags come along and steal away the affections and persons of the females. The ruff or mane spreads out in the beginning of the season; the neck appears to be double the usual thickness. It has been estimated that stags lose from three to four stones during rutting, a circumstance not to be wondered at when one recalls the conditions. They do not take time even to eat then, and are moreover quite worn out by their incessant chasing off of rivals apart from their sexual duties. Many stags by the end of the season, appear as though almost blind and scarcely able to walk So stupid do some of them become that they have sometimes the appearance of attacking rather than avoiding man. Thus stags are at their worst on the approach of winter; hinds, on the other hand, are at their best. The rut over, stags prefer their own society to that of the females. A walk in a Strathspey deer forest in January, 1909, revealed within ten minutes a combination of past tragedies such as might not again be seen for a lifetime. There was a dead fox (probably poisoned), almost wasted away from the long time it had lain on the heather. Parallel to and within ten feet of the body lay a roe deer at full length, its thin, graceful forelegs stretched out. The association of fox and roe was certainly rather odd, but the latter had only been dead for a few weeks, and so reynard could have had no part in its death. Five minutes' walk further along a dead stag was come on—a very lean four-pointer. How had he perished? No bullet wound could be seen, but the chest was badly bruised; suggestive of injury in the rutting season. In an attempt to break in on "a monarch of the glen's" harem he had received prompt punishment, but had lingered on, unable to feed properly, and so had died of absolute starvation, as the state of the body indicated. Within a hundred yards lay a hind whose condition had been by no means perfect, though why she had succumbed was not very clear. The crows had been banquetting on the carcass, the marks of their beaks being numerous; foxes also had come on the scene.

Deer, through ruminants, owe more to their noses than to eyes or ears; sportsmen may and do deceive the last two organs, but the sense of smell cannot be overcome. Old stalkers and poachers believed that the "pit" below the deer's eye was the means by which the animal winded them. Under the best atmospheric conditions, in favour of the deer, they can scent a man at the extreme distance of a mile and a half; should he smoke the range may be increased to two miles. They have been known to refuse to cross a man's track more than four hours after he had passed along; but rain may destroy the scent in ten minutes. Deer have frequently been seen hesitating when they come on the scent of man on a path; then, following a daring leader, they will jump across it, evidently thinking that thereby they escape some hidden danger. They have strong objections to going with the wind; when they do move "down wind" a change of weather is probably impending.

Stags are really peaceful animals, and generally on good terms with their fellows—except in the rutting season. They do not enter on a fight as do bulls and rams; they usually run or walk some distance in parallel lines before facing each other—a combat is primarily a struggle for position. How cautiously, and as if by mutual consent, the two stags will move from soft to hard ground, each taking care that the relative position remains unaltered. The stag which secures the upper position on a hill slope quite realises his advantage; so does his opponent, who, failing to exchange stations, may take an opportunity of bolting. A prod in the haunch is the final danger to be avoided when the weaker makes up his mind that he has had enough of it. Occasionally the severity of the fight approaches to savagery; the head of the defeated has been found with both horns *pulled out* by the victor. A mutual challenge does not always end in a duel, for the roaring, begun at a considerable distance, which sometimes neither cares to lessen, may last for hours. The indifference of hinds to the result of a life and death combat between two claimants for their society is remarkable. They simply wait for the survival of the fittest.

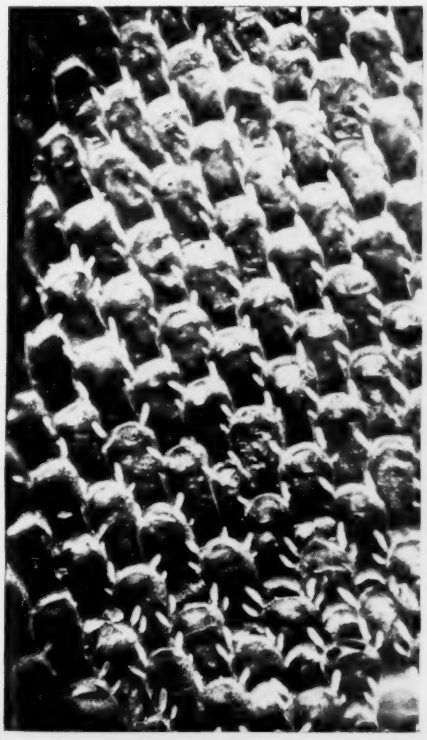
## New Isenthal Rheostats.

MESSRS. ISENTHAL have sent us a copy of their 1910 catalogue of Rheostats in which some cheaper forms of these almost ideal resistances are described. The chief feature of the new types is their combination of lightness with effectiveness in the dissipation of energy—a result which has been ingeniously obtained by the use of oxydised wire, the microscopically thin film surrounding which is sufficient insulation to it, and permits the use of a very large number of turns of wire without undue increase of weight. These advantages are no less apparent in the cheaper forms of Isenthal rheostats than in the more elaborate apparatus.

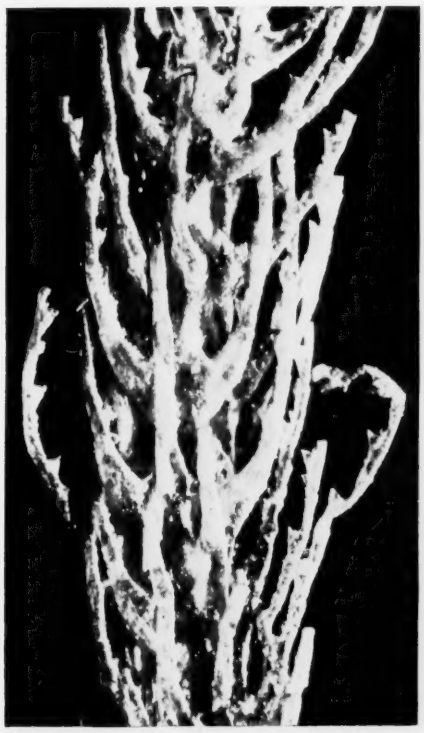
# British Zoophytes.

Flustra Foliacea (Broad-leaved sea mat).

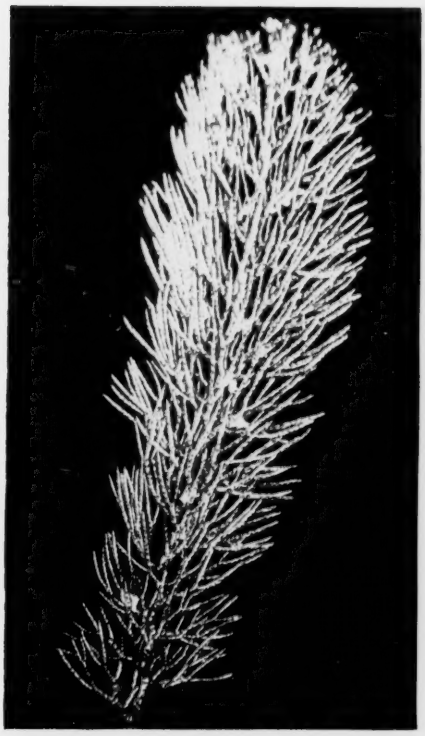
Egg of Dog-fish attached to Gorgonia.



Flustra Foliacea.



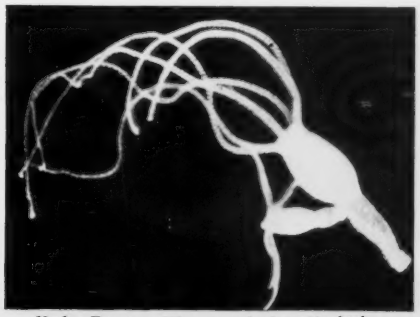
Stem of Lobster's Horn Coralline (Antennularia antennina).



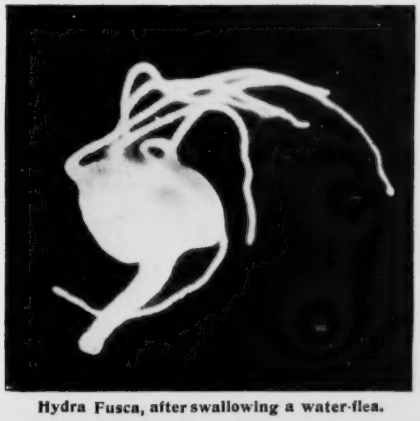
Bottle brush (Thuiaria thuia).

Alcyonidium Parasiticum (Parasite on plumularia falcata—sickle-beard).

Fresh-water Hydra—budding (Hydra vulgaris).



Hydra Fusca, with young hydra attached.



Hydra Fusca, after swallowing a water-flea.

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## A Theory of the Structure of the Solar Photosphere.

By H. S. SHELTON, B.Sc.

No problem in astrophysics is more interesting or apparently more insoluble than that concerning the structure of the solar photosphere. Surrounding the glowing mass of the sun is a brilliant surface from which arises a radiation unparalleled by that emitted from any terrestrial source. This surface layer is very thin, infinitesimal compared with the diameter of the sun; so thin, indeed, that it is continually being broken by those periodic outbursts of solar storms which we term sunspots.

As yet the only intelligible theory that has been put forward is that the photospheric layer consists of solid or liquid carbon and silicon resting on the fluid, possibly gaseous, mass of the sun. This theory, being the only one extant, has attained considerable vogue, notwithstanding that it is involved in a number of serious difficulties. It is not easy to explain why the carbon and the silicon should continually maintain this surface position; and, moreover, though the actual temperature of the sun is unknown, the very lowest estimate is vastly greater than that which would be required to volatilise, not only carbon and silicon, but every known terrestrial substance.

Nor is this theory rendered more probable by a detailed study of the solar surface. The photosphere is not a homogeneous bright surface, but is distinctly granular, and has been variously described as resembling rice-grains, snow-flakes, and willow leaves. Near the edge it appears to break into bright streaks called faculæ, and, surrounding a sunspot, it presents an appearance described as resembling filaments.

Many characteristics suggest that this surface is metabolic. More especially can this be inferred when a sunspot is subsiding. The reformation of the photosphere does not occur by a process of gradual subsidence. The cavity is bridged suddenly in a manner that suggests the analogy of a colossal flame shooting across the abyss. No description is so apt or so adequate as this. Observation and imagination, unhampered by scientific theories, irresistibly suggest that the sun is surrounded by a surface of flame. This, however, would not be seriously suggested as a scientific theory because flame connotes burning, burning chemical action, and we are unable to conceive what chemical change can be taking place. As Lord Kelvin so clearly pointed out, if the whole sun were burning coal, its heat would be exhausted in a few thousands of years.

Recent astronomical and chemical discoveries and speculations, however, render it not unlikely that this crude and primitive guess may be nearer the truth than modern and more scientific theories. It now seems not improbable that the origin of a considerable proportion of solar heat may be found in some form of intra-atomic change, which, to distinguish it from ordinary chemical or intra-molecular action, we will term metachemical.

The full evidence of this theory cannot be set forth in a brief article, but the following *résumé* of modern fact and theory will suffice to show how much it is competent to explain.

1. In the first place we must note that, without the aid of metachemical action, we are totally unable to understand how solar radiation has been maintained throughout geologic time. If we accept the evidence put forward by Mr. Strutt and other exponents of the science of radio-activity, the geologic age of the earth must be at least several hundreds of millions of years. Other lines of investigation point to the same conclusion. In addition to this vast lapse of time the sun must have been giving off light and heat for eras before the crust of the earth first solidified. On the other hand, making every reasonable allowance for causes of uncertainty, the gravitational theory of Helmholtz will not account for more than 50 millions of years. Thus we find an enormous discrepancy.

2. Sir Norman Lockyer and other advocates of the idea of inorganic evolution have shown that many facts disclosed by the science of astrophysics can be rationally explained if we assume a progressive elemental change in the stellar universe.

3. Recent discoveries in radio-activity have proved that, when elemental change occurs, it is accompanied by an evolution of energy unparalleled by that produced from any other known source.

Putting together these three lines of argument we can see how very probable it is that a large proportion of solar energy may be due to some form of metachemical action.

Starting with this suggestion we will now consider in what form this action may occur. It is immediately clear that this, if it exists, cannot be due to any known radio-active element. The evidence of spectroscopy shows clearly that uranium and thorium, the ultimate sources of all known radio-active products, if present at all, are not to be found in the sun in a proportion adequate to affect appreciably its output of heat. We are, therefore, bound to look for other substances. But, when we do so, we are met with the suggestion that known elements, stable under ordinary conditions, may, at the temperature of the sun, undergo intra-atomic change. This idea, as we have already seen, is supported by much astronomical evidence, and, moreover, nearly all the lines in the solar spectrum can be referred to some known terrestrial element.

At this point we must consider one possible objection. Our experience of terrestrial radio-active elements has not yet disclosed one instance where we have been able to affect the rapidity of disintegration by any alterations of physical conditions. We must not, however, be too ready to assume that this indifference to temperature and pressure is absolute. We must note that as yet we have witnessed no atomic integration, only disintegration. All known radio-active changes are exothermic. How, then, did these radio-active elements arise? That they are temporary shows that they must have had a beginning in finite time. In some way or other, under some unknown physical conditions, this radio-active process must be reversible. We can, therefore, well imagine that elements which, under all known conditions, are stable may yet be unstable when subject to the colossal temperature of solar and stellar heat. While noting the indifference of radio-active elements to such influences as we can bring to bear, we must not forget that such sources of energy as we have at our command in the laboratory are infinitesimal compared with the vast energy equivalent involved in radio-activity. Many ordinary chemical processes and decompositions are indifferent to moderate changes of temperature.

In this manner we are led to the conception that each element may possess its own particular range of stability and critical temperature of change, and that, when this metachemical action occurs, vast stores of energy are evolved.

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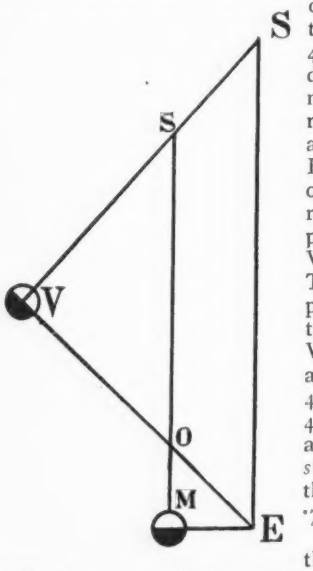
If we assume that this is a considerable source of solar heat, the peculiar characteristics of the photosphere immediately find a rational explanation. In the sun we have an enormous material mass at a colossal but unknown temperature. The greater part of this is in comparative thermal equilibrium, and so we should not expect metachemical change to occur. But, at the cooling surface, heat is evolved. The conditions of equilibrium are disturbed. There, if anywhere, we should find the conditions for metachemical change. The critical temperature of this or that element would be passed and the matter would assume the stabler form at the altered temperature. In so doing energy is set free and we should expect that the surface of intra-atomic change would be the active surface of radiation. The structure would be metabolic and there would be a continual circulation of matter from the interior of the sun into and out of this photospheric layer.

Every known characteristic of the photosphere could thus rationally be explained—its position, its metabolism, its intense radiation, its appearance at a certain stage of stellar evolution, its flame-like structure, and its enormous temperature. On the metachemical theory of its origin it can well be described as a superflame.

## An Astronomical Problem.

By W. J. MILLAR.

ON November 20 last the moon was in first quarter, Venus about that time was also half illuminated. The observed angle between the Moon and Venus was 42°. From the annexed diagram we may determine approximately the relative distance of Venus at that time from the Sun. In the Fig. M E V is the observed angle of 42°—E representing the Earth's place, M the Moon, V Venus, and S the Sun. The lines joining these points give us two *similar* triangles, so that the angle V*s*O becomes equal to the angle OEM—which being 42° the angle at *s* is also 42°, and since the angle at V is a right angle, if *s*O be considered as unity, then *s*V = cos. 42° or ·743.




Now, as the distance of the Moon (represented by ME) is very small compared with the distance of the Sun, we may practically neglect it and consider the line *s*M to approach nearer and nearer to S E, hence we may then take the triangle V S E as representing the triangle V*s*O, and now we have ratio of V S to S E as ·743 : 1. That is to say, that the distance of Venus from the Sun at that time was ·743 of the distance of the Earth from the Sun. From a previous observation the ratio was found to be ·707, the mean of these is ·725, which is very close to the recorded mean distance of Venus from the Sun, viz., ·723.

## British Zoophytes.

### Their Treatment with Camera and Microscope.

By J. H. CRABTREE, F.R.P.S.

THAT interesting family of individuals which live, move, and have their being in and around our own homeland appears to have escaped from the curricula of our studies, and to have been relegated to the sphere of "things forgotten."

This is unfortunate, insomuch as no sphere of natural history presents greater possibilities of research and new discovery than the specialised study of zoophytes, while to the photographer, and especially the photo-micrographer, the area of investigation is absolutely limitless. Here is such a glorious opportunity for "new matter," and new presentations of old ideas, that it affords positive pleasure to revel with the lens among these strange entities which have puzzled scientists in this and all previous ages.

What a zoophyte is, or is not, does not fall within my present purview. I rather wish to invite attention to specimens living around us, and to consider some of their main characteristics. I should like, further, to show how they may be portrayed felicitously by means of the camera and microscope.

Perhaps the most popular of all our zoophytes may be discovered in the nearest pond. The fresh-water hydra is well known and affords an excellent type for the whole family. *Hydra vulgaris* abounds in weedy ponds, canals, and slowly-moving streams. In all the specimens which have come under my observation the reddish hue has been present, or very nearly approached by a reddish-brown or orange. This tint is largely dependent on the food of the animal; it devours minute worms and larvæ, many of which contain red blood-corpuscles. The tentacula vary in number from five to eight; the number 7 appears to be most general.

It has been held by some investigators that in the process of budding one part only of the body is used for gemmation; that a bud forms at this spot, grows to adolescence, and then breaks from its parent; that another bud forms on the cicatrix to pursue its career similarly. Careful observation, however, of the life-history of a single hydra will show that buds may form on any external part of the animal's body and assume, in all respects, the characteristics of the parent.

*Hydra fusca* is a long-armed creature which obtains very largely in stagnant pools and gentle water-courses. The tentacles are much longer than *H. vulgaris*, being from four to six times the length of the body. They are also more agile, and bristle with excitement when in the vicinity of prey. If a water-flea comes near these wily feelers he is immediately struck by their sharp points, meshed round as in a web, and the tentacles thrust him, *en masse*, through the only orifice of the hydra into the captor's body. Then the excited feelers fall limp; the hydra has an ample meal for a few hours at least.

To photograph the hydra with any degree of perfection we must combine the camera with the microscope. I have found 2-in., 1-in., and ½-in. objectives suitable for this purpose, and prefer to work without eyepiece. If the animal presents a fair amount of detail in the parts which are semi-transparent, then transmitted light may be used to advantage by means of an incandescent gas-mantle with a condenser intervening between light-source and the stage of the micro-

scope. If, however, this detail be obscure or of little importance reflected light should be used as conveying the idea of natural relief in the finished micrograph. When using reflected light I invariably screen the gas-mantle on all sides, allowing only a slit of light to pass in the front of the chimney, then through the condenser on to the object.

Hydraidæ should be mounted in liquid with their tentacles extended. Dried specimens are practically useless.

For the majority of our native zoophytes we must look to the sea shore. Often enough as we pace the tidal area we encounter a mass of heterogeneous material which seems to merit neither fear nor favour. But look one moment through a pocket-lens at one specimen, and the wonderful bursts into view.

*Flustra* (sea-mat) in its various forms is most common on all our shores. *Flustra foliacea* is cast up with every tide. Every storm rends millions of these animals from their sea-girt home. I have seen the Lancashire coast between Rossall College and Cleveleys carpeted with the skeleton remains of these zoophytes. When freshly deposited they emit a pleasant smell not unlike that of an orange. Their appearance under the microscope is delightful, revealing regular lines of cells with horny processes, and the minute operculum near the apex of each cell.

*Flustra truncata* is frequently met with on our north-eastern shores, in Northumberland, Durham, and Yorkshire especially. It is rarely found on the S.E. coast, but on the west coast of Ireland it is abundant. Its fronds bear a strong resemblance to a series of truncated cones. The edges are sharply angular and have the cells closely woven. All flustræ should be treated with reflected light for the purpose of photo-micrography, and powerful rays should be directed at an angle of 30° to the object. This arrangement accentuates the deep shadows between the cells.

Sertularians have a numerous family on our seaboard. The whole of the west coast is littered with a dozen different varieties. Among these *S. filicula* (fern coralline) are commonly found near the tide-line. The remnant of this zoophyte is distinguished by its wavy rachis or stem, emitting alternate branches with denticles in close and regular series. The polypes have disappeared before the zoophytic skeleton is gathered; but one stem with its branchlets affords the interesting revelation that 2,000 living creatures once lodged therein. The zoophyte is generally parasitic on sea-weeds and on sea-mats, and is well distributed about all low-water lines. Branchlets are frequently occupied by colonies of *planorbis*, which suck the juicy polype from its cell.

In deeper waters we find *S. argentea*, commonly known as "Squirrel's Tail." It masses on mussel-beds in the deeper channels of estuaries, and in the neighbourhood of dock-gates where water is frequently changing. The whole polypidom or colony seldom exceeds 10 inches in height; each stem or branch carries the polype-cells alternately and nearly opposite each other. Specimens of Sertularia afford a means of printing without camera when only the exact size of a polypidom is required. We lay the specimen on a clean glass in a printing-frame and cover it with ordinary gaslight paper; this is exposed to the flame for a few seconds and the paper developed forthwith in metol-hydrokinone. The result is a white figure of the zoophyte on a jet-black ground.

Plumularian zoophytes are most common on the shores of Scotland and North of England. *P. frutescens* is found in abundance off the coast of Durham and North Yorkshire. The polypidom is 5 inches high, hard and woody, and of a dark-brown colour. It lives in deep waters, attaching its root-tendrils to stones or shell-fish. From February to May the pinnæ, of which there are hundreds on each branch, are well covered with vesicles. These, however, do not nearly approach the crowd of polypes on *P. falcata* in the early months of the year. This "sickle coralline" selects a habitat among the rocks and shell beaches where it forms an elegant crop 4 to 6 inches high. It is readily distinguishable by its spiral stem and the sickle-shaped pinnæ on the branchlets. The cells closely follow each other on each pinna, but there are no cells on the main stem.

The fishermen of Scarborough, Whitby, and the Hartlepools are well acquainted with "bottle brushes." These—*Thuiaria thuia*—are zoophytes having a remarkable semblance of such articles, and are unwelcome habitués of deep water in fishing-grounds. They often rise 12 inches from their fibrous roots, the main stem being crowded with branchlets as the polypidom grows. Eventually the branchlets on the lower portion of the stem break away entirely, leaving knotty projections. The vesicles appear in two rows on each pinna, but the stem is quite free from cells.

The lobster's horn coralline—*Antennularia antennina*—thrives abundantly on our sandy beaches. Its clusters are striking if they are found before the pinnæ are stripped from the main stem. Then these pinnæ bear the appearance of a number of sickles bending inwards. In this direction also the vesicles all turn with wonderful regularity.

The herring-bone coralline—*Halecium halecinum*—is a boon companion of the "lobster's horn," and is generally cast up on the same beach. This zoophyte resembles the bare trunk and branches of a tree in miniature—being only 6 inches high—except that its root is intertwined with some pebble or shell. The whole structure is strong and brittle, each polypidom housing not less than 1,000 living entities.

Of a different species is the *Alcyonidium parasiticum*, which, as its name implies, is profusely parasitic on corallines generally. It spreads along the stem and branches, coating them with a porous encrustation of sand and earthy matter. It sometimes covers its victim so completely that the appearance of the coralline itself is obliterated. Though porous, the covering is not spongy. If dropped in a glass of water it sinks to the bottom immediately. Mineral acids do not affect it; nor does it possess any power of absorption. If rubbed in the hand it falls to mere powder.

The Gorgon zoophytes are among the most striking of our native types. Their general fan-like appearance in gaudy-red or reddish-brown colours mark them at once as "gems of the sea." When cast ashore much of their beauty has departed. The red fleshy envelope becomes a friable, porous crust around a hard, leathery axis. The orifices at the margins of the branches were occupied by the polypes during life. *Gorgonia anceps* is said to be extremely rare on British shores. I have, however, found several good specimens cast up on the Welsh coast and on the shores of Morecambe Bay. In some instances I have found them used by the dog-fish and skate during the spawning season. The tendrils of the egg are wrapped tightly round a group of Gorgon branches with an air of perfect security.

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## The Conservation of Mass.

By ALFRED W. PORTER.

THE invariability of the total mass in the universe—an idea taken as the starting point of analytical chemistry and also of the theoretical speculations of the greater part of the nineteenth century—has in more recent times had considerable doubt cast upon its validity. In two articles contributed to "KNOWLEDGE" some time ago* I dealt with that part of this question which concerned a possible change of *weight* in chemical reactions and tried to make clear to what extent experiments indicating a change of weight implied also a change in the *mass* of the reacting bodies; the two quantities *mass* and weight being by no means identical.

I now return to this subject with the object of considering the recent work which directly attacks the fundamental conception of the absolute invariability of mass itself.

This question involves the recent advances which have been made in our knowledge of electricity and magnetism. These two branches of knowledge—electricity and magnetism—have gradually become blended together until it has become certain that we cannot know all about either until we know all about both. As long as we consider the electrostatic charges upon bodies or stationary magnets there is no evidence of any connection between them. Each might be a distinct thing of its own kind without any mutual relationship with the other. Around a charged body there extends its electrostatic field of force (the electrical *atmosphere* of the earlier writers) which determines the attractions or repulsions which occur when other charges are brought into the neighbourhood. In the case of a small charged sphere this field of force can be represented by straight lines radiating away from the centre; for it is along such lines that the attractions or repulsions will take place. Around a magnet again there also exists an "atmosphere" of influence. Iron filings arrange themselves into the familiar lines when placed on a card in the neighbourhood of a magnet. Magnets disturb each other and we speak of a magnetic field of force around them. If both charges and magnets are present both of those actions occur simultaneously without any mutual interference, each just as though the other were absent.

But the early experiments of Oërsted, followed by Ampère, Faraday, and Weber, showed that the two are after all intimately connected. An electric *current* such as flows from a charged body when it is discharged behaves like a magnet. If a Leyden jar is discharged through a coil surrounding a needle this becomes magnetised—as was first shown by Savary, and afterwards by Joseph Henry. A current from a galvanic cell is similar in every essential quality to the current from a discharging jar, and Ampère and Weber proved that a small coil carrying a current has a field of force round it similar to that of a magnet. Experiments made since, and indeed all accurate investigations in which an exact knowledge of the relationship is required, prove that as far as magnetic effect is concerned a current flowing round a single circle of wire behaves like a magnet consisting of a thin sheet of iron of the same contour as the circle, one face of it being magnetised with north polar and the other with south polar magnetism. It is only the broad relationships that can be dealt with here; for details with respect to quantitative measurements the reader must consult any elementary treatise on Electricity and Magnetism. We will mention merely that a long magnet can be conceived as having *poles* near its two ends of north and south *magnetism* respectively (speaking as though magnetism were a substance which we have no reason to believe it to be) and that if a pole repels a pole of a precisely similar magnet when placed at a distance of 1 cm. in air with a force of one dyne, the strength of the pole is said to be unity. In other cases

$$\text{Force in dynes} = \frac{\text{Strength of one pole} \times \text{Strength of second pole}}{(\text{Distance between them in cms.})^2}$$

If the strength of a pole is unity the force upon it in dynes is called the strength of the magnetic field at the point where it is.

On the basis of these definitions we can state a very general law which holds between an electric current, C, and the magnetic field due to it. In the first place, if we draw a continuous line such that at any point of it its direction is that of the magnetic field, this line will form a closed curve, called a line of force, embracing the current. [If we could isolate a magnetic pole and permitted it to move *slowly* under the influence of the field it would travel round and round the current along a line of force.] Divide such a line of force into very short lengths, multiply each short length by the strength of the field at a point contained in this short length, and add all these products together, the sum* is in every case equal to $4\pi \times$ strength of the current where $\pi$ is the ratio of the circumference of a circle to its diameter. It is not always possible to apply this law, though it is always true; but in cases in which sufficient aid is supplied by other considerations it forms a very useful law. Take, for example, the case of a very long straight current; the lines of force in this case are circles with their centres in the wire. The similarity of circumstance at every point of any one such circle indicates that the magnetic field will have the same value at every point of it; call this value H. Now if we divide the circle into n very short lengths, each equal to $a$, the left-hand side of the equation is

$$n\,H\,a = H\,n\,a = H \times \text{circumference} = H \times 2\pi r,$$ where $r$ is the radius of the circle.

This is the quantity which we have stated to be equal to $4\pi C$. Hence

$$H = \frac{4\pi C}{2\pi r} = \frac{2C}{r}.$$

This equation asserts that the field at a point is proportional to the current and inversely proportional to the distance of the point from the current.

This is the first great cross-connection between magnetism and electricity. The second one, due to Faraday, is of a reciprocal kind. It is the law of *induced* currents, due to the motion of magnets in the neighbourhood of conductors. Motion of a magnet sets electricity in motion in adjacent conductors.

The current excited can be expressed as

$$\frac{\text{Electro-motive force}}{\text{Resistance}} \qquad \text{(Ohm's Law.)}$$

The resistance is a property of the conductor itself; it is the electromotive force which is due to the moving magnets, and its magnitude is

E = rate of decrease of the number of lines of magnetic field passing through the aperture enclosed by the conductor.

In the first case we found electricity in motion pro-

* "KNOWLEDGE," December, 1904, June, 1905.

* More strictly is it the limiting value which this sum approaches as the number of pieces into which the line is divided is made greater and greater, the pieces being, of course, of correspondingly diminishing magnitude.

ducing a magnetic field; in this second case it is magnetism in motion producing a displacement of electricity.

What then is this electricity about which we thus speak as though it were a corporeal entity capable of motion? On into the nineteenth century it was certainly conceived of as a substance; sometimes of a single kind present in excess in a positively charged body, in defect in a negatively charged one; sometimes of a two-fold kind, that is a positive variety and a negative variety, existing in equal amounts in every part of an uncharged body but otherwise in unequal proportions. The reasons given for this belief were multifarious; the Abbé Nollet knew that electricity was a substance because he could smell it!

Maxwell, developing Faraday's ideas, discountenanced this view. Faraday had called attention to the "atmosphere" surrounding electrically charged bodies; to Maxwell, this atmosphere, or the electric field, as it had come to be called, appeared to be everything that there was. Although he used the old nomenclature and ideas, it is plain that he looked forward to a time when they might be dispensed with. He spoke of electric charges; he even regarded them as divided into molecules like ordinary matter—a conclusion to which he was led by the phenomena of electrolysis; but he declares these to be merely provisional hypotheses which would be ultimately discarded. We have advanced by going backward since Maxwell's day in so far as that these "provisional" hypotheses have been placed on a firmer footing than ever. In fine, it is found that it is not possible to conceive of and describe electric phenomena without assuming the existence of at least one electrical substance. The reasons for this we will develop in the next part.

*(To be continued.)*

## An Eagle's Education.*

A FASCINATING description of the growth of an eaglet and of its education by its parents has been penned by Mr. H. B. Macpherson, who has been persevering enough and fortunate enough to be able to illustrate his observations by a series of beautiful photographs which, in their consecutiveness, are unique. The nest of the pair of Golden Eagles which form the subject of his book is in a deep and lonely corrie of a Grampian deer forest, and had been sedulously protected for a number of years. Three years ago Mr. Macpherson had photographed a young eagle at different stages of his growth, but when on April 23 of this year he learned that the nest which had been for some time unoccupied was again tenanted, and that the female eagle was sitting on two eggs, he made elaborate preparations for recording the subsequent occurrences. He was successful to a marked degree, as is attested by thirty-two photographs, beginning with one of the two eggs in the nest, and ending with the first essay in flight of the young eagle who was the survivor of the two that were born. The greatest precautions had to be taken. "The fact should be noted," observes Mr. Macpherson, "that on no occasion did I see the eagle *rise* from her nest. She invariably flapped down the corrie close to the side of the hill, and, subsequently, either soared gradually upwards, or sat watching us on a point of rock about half a mile away. During a long experience of eagles I have never known the parents return

* "The Home Life of a Golden Eagle." Photographed and described by H. B. Macpherson. With thirty-two mounted plates. (Witherby and Co.) 5/- net.

**The Golden Eagle and her Eaglet in the Eyrie.**

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to the eyrie when a man was near, if the man was within their sight, nor have I seen them make the slightest effort to drive away the intruder, far less to attack him, as has sometimes been reported, with wings and feet. Of all our sky birds the eagle is the most timid, and generally remains out of sight for an hour or more if disturbed from the nest."

In these circumstances some of the photographs had to be taken at intervals that were comparatively considerable. It was in one of these intervals that one of the two young eaglets disappeared. The mystery of its disappearance was never solved. But by dint of submission to considerable hardship the career of the remaining eaglet was followed with the omission of no essential feature. Mr. Macpherson's observations comprise all the provisions for sheltering it, feeding it, and teaching it, which its parents made. Among the most interesting of his observations are those connected with the efforts to teach the eaglet to fly. The lessons began with attempts to tempt him by offers of food to points more and more distant from the nest. At last, after the mother eagle had scolded and even buffeted her offspring—"the eaglet cheeped continuously till, as though seized by some irresistible impulse, he flapped to the very edge of the abyss and turned his head from side to side, listening to her call. And now he, too, changed his cry, his voice seemed to break, and the adult yelp, though in a lower and feebler key, burst from his throat. . . . The young eagle gazed around him as though taking a last farewell of his birth-place, spread out his giant wings, and vanished for ever from my sight among the ledges below. . ."

From the time of his birth to that of this his first flight eleven weeks had elapsed.

## A Simple Method of Photomicrography.

By JAMES H. SHORROCKS.

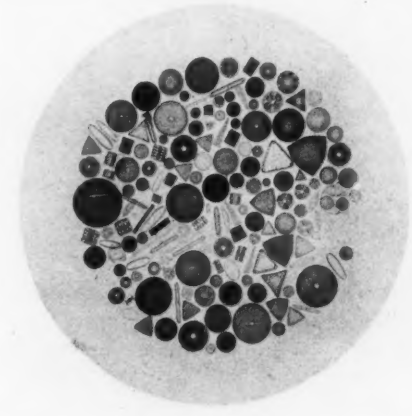
IN the columns of "KNOWLEDGE" and elsewhere one occasionally sees accounts of home-made simple and cheap apparatus for the purpose of taking photomicrographs. Such apparatus, in the form of a framework or improvised camera of some kind, may be quite efficient, but it is not everybody who has the patience and ingenuity to put such things together in a satisfactory manner. Many who would be glad to be able to take photomicrographs may be deterred quite as effectually by the amount of trouble and skill required to fit up arrangements of wood and cardboard, as by the expense of the ordinary apparatus.

Some time ago I undertook experiments with a view to finding out the best plan of using an ordinary camera in conjunction with the microscope for the production of photomicrographs and succeeded in arranging a simple and easy method, which I recently described and demonstrated at a meeting of the Manchester Microscopical Society. The exposure was made by means of an oil lamp, in the full glare of the electric light, which was then switched off whilst the plate was developed and fixed, and, within a few minutes for the whole process, a negative of the object under the microscope was produced. The method can be described in a few words.

The microscope is placed in a horizontal position, and the object focussed by looking through the eyepiece and focussing in the usual way. The camera lens is set about infinity point, or as for photographing distant objects. If the camera is a fixed focus one, this, of course, is not necessary. The camera is then placed in front of the microscope with the lens close to the eyepiece, raising the camera, if necessary, to the proper level by placing some support under it. I preferably set the camera lens at full aperture, so that the orifice of the cap of the eyepiece acts as a diaphragm. The exposure may be for five seconds or more according to the nature of the object, the lighting, and the rapidity of the plate. The plate is then developed in the usual way.

Thus, with a microscope and ordinary camera, one is fully equipped. I generally use a quarter plate folding pocket camera. Nothing further is required in the way of apparatus. There is no baseboard but the table, no framework of any kind, nothing to be made or bought, no disturbance of eyepiece of microscope or lens of camera, no focussing of the camera, and the operation, except the development of the plates, can take place in a lighted room, without any necessity for covering or protecting from the light the junction of the eyepiece and camera lens.

**Tongue of Hive Bee × 11 dia.**



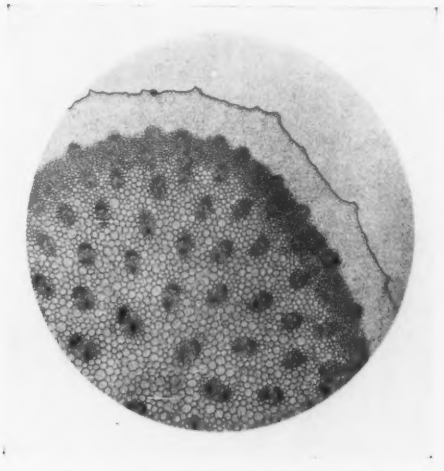
**Diatoms × 18 dia.**

The photomicrographs sent herewith are all taken by this method. They represent various classes of objects; also various methods of lighting—namely, by transmitted light, reflected light, dark-ground illumination with paraboloid, and vertical illumination. The objec.

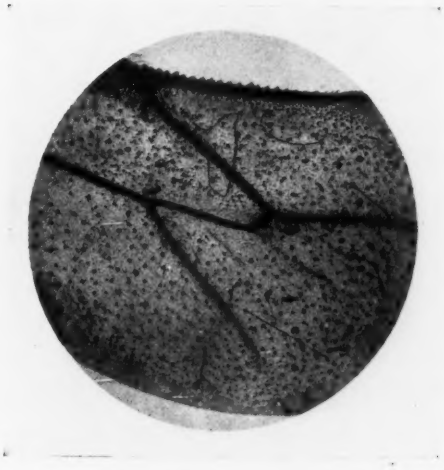
tives used for these photographs were 3 inch, 1½ inch, and ⅔ inch, with eyepiece magnifying five times, giving a disc of 3 inches and a magnification, by actual measurement of the photograph, of 11, 18, and 36 diameters respectively.

There is no difficulty whatever in the process for such magnifications as these, which suffice for most of the requirements for which prints or lantern slides are wanted.

I do not claim that this process is altogether new, for I have had my attention called to allusions to something of the kind having formerly been done, but I believe I



**Transverse section of Stem of Butcher's Broom × 18 dia.**



**Posterior Wing of Bee × 18 dia.**

have carried the elimination of apparatus and precautions to a greater extent, and the dispensing with the focussing of the object on the focussing screen of the camera constitutes a further simplification and new departure, I think. The focussing is done on the retina of the eye with the microscope alone, and then, like a great eye, the camera with its lens is placed to the eyepiece of the microscope, and the image which is received on the sensitive plate is secured by development.

In more recent experiments I have noted further facts which will allow of adjustments being made, and so I believe will extend the scope of the method indefinitely.

## The Evolution of Leaf-Structure.

By H. A. HAIG, M.B. (Lond.).

IT is a well-established fact that, according as external conditions of existence have varied with the succession of the different geological epochs, so there have arisen variations in both the external configuration, or morphology, of plant organs and the internal structure, or histology, of those organs. In this respect the leaf forms no exception, and it is probable that this most essential organ has, during the evolution of the vegetable kingdom, undergone marked changes in structure. But although in working up from the simpler types of leaf to the more highly differentiated organs met with in higher plants we find an increasing structural complexity, yet the ultimate functions of the leaf are not found to increase in the same ratio; for in all cases the green foliar organs are *the* structures in which the major part of the carbohydrate and nitrogenous food of a plant is elaborated. In some instances, it is true, leaves are so modified that they are able to digest previously elaborated food, as is seen in the case of the Bladderwort (*Utricularia*) and in the Sun-dew (*Drosera*); but even in these the complex nitrogenous materials taken in (albumen, small flies, &c.) are further acted upon by the protoplasm of the assimilating cells of the leaf, being broken down into simpler substances, and the products subsequently built up again into different compounds, the final product being in nearly all cases an amido-acid. Another function which is common to all green aerial leaf-organs is that of the transpiration of aqueous vapour, a proceeding which results in the drawing up of raw sap from the roots and ultimately from the soil. In the submerged leaves of water-plants this function is, of course, absent, since water with the requisite salts in solution surrounds all organs of the plant, and no transpiration current is necessary. In those leaves which float on the surface of water, the roots being embedded in the submerged soil, a transpiration current occurs, since evaporation of aqueous vapour takes place readily from the upper surface of the leaf during direct sunlight.

We will now turn to the consideration of the modifications of internal leaf-structure which have arisen to cope with either varying external conditions or increasing needs of the plant consequent upon evolution from a lower to a higher type; both of these influencing factors may, of course, be in action at the same time, and, in fact, increasing differentiation to cope with altering external conditions has been at times a powerful factor in the history of plant evolution.

Pseudo-foliar organs are first met with amongst the Liverworts and Mosses; the flat thalloid Liverwort, *Marchantia*, is to all intents and purposes a simple type of foliar organ, every cell of the thallus being a typical assimilating cell in which sugar, starch, and nitrogenous food are synthesised for further use, some being used at once and some stored. A thalloid organ such as the above is composed of merely a few layers of chlorophyll containing cells, and on the upper surface are to be found air-pores, comparable to the stomata of higher types of leaf, which function in permitting entrance and exit to the gases of respiration and assimilation, viz., oxygen and carbon dioxide. A vascular system has not yet been differentiated in such a plant, and the necessary water is derived from the soil by means of "rhizoids," which are structures not unlike root-hairs springing from certain of the cells of the lower surface of the thallus. In the so-called foliose Liverworts structures having more

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the resemblance to the higher type of bifacial leaf and springing from a central axis are to be found, but even in these the internal structure is extremely simple, there being but a few layers of assimilating cells present, and no sign of a vascular system.

The leaf of a Moss-plant is but little more differentiated than that of the Liverwort. A few layers of assimilating cells are found, with stomata here and there on the upper surface, and towards the central axis of the leaf a few elongated elements possessing spiral thickenings upon their walls. These latter are rudimentary conducting strands, and are the first indication of a vascular system; but although these few vascular strands are found both in the leaf and the main axis of the Moss-plant, the Mosses are not grouped with the Vascular Cryptogams.

Up to this point then, we have found that practically the only type of tissue found in these rudimentary types of leaf is the "assimilating" tissue, composed of chlorophyll containing cells, full of cell-sap, and possessing a delicate peripheral layer of cytoplasm lining the cell-wall internally; this tissue is characteristic of all leaves, whether of a low type or highly differentiated, and the variations which occur in different foliar organs, although they tend to affect the distribution of this tissue, do not as a rule go to reduce the relative extent of it in the leaf.

In the group of plants next above the Bryophyta, viz., the Vascular Cryptogams, we meet for the first time with a type of leaf which is characteristic of many of the higher plants; in this type, a distinct layer of assimilating cells, the so-called "mesophyll," or "spongy parenchyma," is present, bounded by the epidermis of upper and under surfaces of the leaf. In the mesophyll run vascular strands composed of spirally thickened elements, surrounded by a few thin-walled cells, which communicate with the sieve-tubes of the phloem in the leaf stalk and stem, whilst occasionally a few thicker-walled fibres (sclerenchyma) may be seen forming a sort of supporting framework for the more delicate elements of the vascular strand. Such a type of foliar organ is known as "bifacial," and is exemplified in many leaves of the higher plants (Ferns, Dicotyledons, Monocotyledons, &c.) [See fig. 1].

In such a leaf stomata usually exist in fairly large numbers in the lower surface, and in somewhat less number upon the upper or dorsal surface, although there is no actual law governing the relative proportions of stomata occurring upon the two surfaces.

In the bifacial type of leaf, then, the assimilating tissue is, as a rule, spread out, so as to cover a relatively large area, and the ultimate ramifications of the vascular bundles in the petioles pass through this tissue, branching in various ways until, as a rule, they join lateral branches which pass along the edge of the leaf. There is thus every facility for the conduction of raw sap to all parts of the mesophyll, and the transpiration of aqueous vapour is greatly aided by such a disposition of the assimilating and vascular tissues.

The mesophyll of a bifacial leaf is in the majority of instances made up of two main types of cell—viz., the thin-walled somewhat irregular cell of the true "spongy parenchyma," or transpiratory tissue proper, and the so-called "palisade cell"; the latter is found just beneath the epidermis of the upper side of the leaf, and large numbers of these cells are arranged in rows, forming the "palisade parenchyma." Each palisade cell is columnar in shape and is characterised by the possession of large numbers of chloroplasts; the palisade cells, are, in fact, the main elaborating cells of the bifacial leaf, and although the spongy parenchyma can, by reason of the possession of a certain number of chloroplasts, manufacture sugar and starch, nevertheless, transpiration is its main function. An interesting point in connection with the relationship existing between the palisade and the spongy tissues is the fact that separate groups of palisade cells appear to rest upon single cells of the spongy parenchyma, and these latter have been termed "collecting cells," from the fact that by this arrangement the sugar, &c., elaborated by the palisade cells is collected and transmitted by these elements.

With regard to the epidermis of the leaf a theory has recently been put forward that the curved outer cuticularised wall of each epidermal cell acts like a lens and serves to concentrate the rays of light, focussing them upon the palisade cells and thus ensuring greater intensity of assimilation; so that, in addition to its acting as a protective layer, the cuticle of the leaf may aid in assimilation.*

The cells of the spongy parenchyma do not form a closely packed mass, but are separated by and surround a system of intercommunicating air spaces which ultimately join the numerous so-called "respiratory cavities" (see fig. 1, r c) which are found in connection with the stomata of the leaf; by this arrangement watery vapour finds an exit from the spongy cells into the air-spaces and finally by means of the respiratory cavities to the atmosphere, finally passing through the stomata. The guard cells of each stoma (see fig. 1, g) are in surface view crescentic in shape when they are "turgid," but at certain times their turgidity decreases, and in this manner the cells become flatter and shrink towards one another, thus lessening or completely obliterating the actual aperture of the stoma. In this way, then, is the actual loss of water from the spongy cells partly regulated, for in dry, hot weather the guard-cells become less turgid and tend to close the stoma. [The transpiratory pores in the thallus

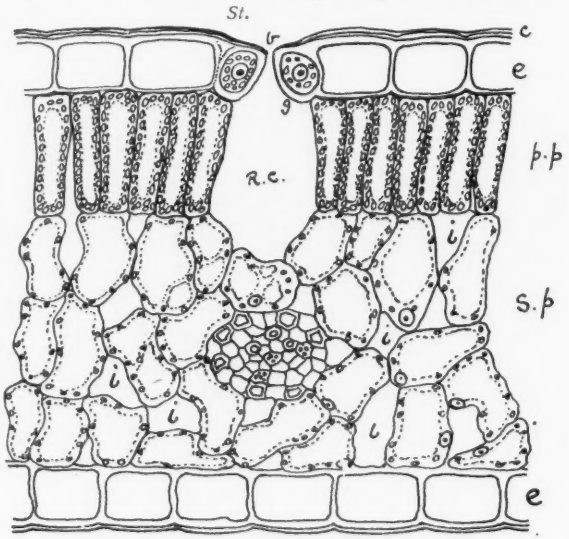


**Fig. 1.—A transverse section across a bifacial leaf.**

e, e. Epidermis.
c. Cuticle.
St. Stoma.
v. Vestibule of stoma.
g. Guard-cells.
r.c. Respiratory cavity.
p.p. Palisade parenchyma.
s.p. Spongy parenchyma.
i. Intercellular air-spaces.
A single leaf-trace is seen in the centre lying in the spongy parenchyma.

* As a rule the epidermis is only one cell thick; but in some cases, notably *Ficus elastica*, the epidermis is three-layered, so that here the above theory would possibly not obtain, owing to increased thickness of the outer layer.

of *Marchantia* are similar in function to stomata, although their structure is somewhat modified; for the ring of cells surrounding the pore is in this case a much more rigid combination than the two guard-cells of a stoma in a bifacial leaf, and is not capable of opening and closing to the same extent.] With regard to the arrangement of the woody and phloem portions of the vascular bundles in the bifacial leaf, it is usual to find the xylem towards the upper or dorsal surface, and phloem towards the lower or ventral aspect; this disposition is sometimes reversed in modified foliar organs, such as the fruit-scale of *Pinus*, where the main bundle entering the scale receives a "twist" during the development of the organ, and thus the phloem looks towards the upper surface of the scale. The reason for this seems to be that the ovule in *Pinus* arises upon the upper surface of the fruit-scale, and during development requires a quantity of elaborated food, which is more easily obtained by this arrangement of the phloem than it would be if the phloem were undermost; it is, in fact, a modification arising during development to ensure the best possible conditions for the nourishment of the developing seed.

The other type of foliar organ which remains to be examined is the so-called "centric" type, in which the mesophyll surrounds a well-defined central cylinder containing the vascular elements of the leaf; the leaves of *Pinus* and *Hakea* are examples of this type (see fig. 2). As a rule the mesophyll in these leaves is composed of one type of cell only, viz., the thin-walled assimilating "spongy" cell, although those cells nearest the surface do generally possess more chlorophyll than the deeper cells, and are thus more functional in elaboration than the latter.

In the centric type, the leaf approaches in structure and disposition of tissues those met with in the stem of the plant to which it belongs, and is as a rule a less highly differentiated organ than the bifacial leaf; in *Pinus* this is particularly obvious, for in this case, the two plano-convex leaves in each pair arise by the bifurcation of a so-called "branch of limited growth," which has a structure very similar to that of the stem. The central cylinder is surrounded, as it is in the stem, by a well-defined bundle-sheath, or endodermis, internal to which lies a tissue, which in *Pinus* is differentiated into a peculiar form known as "transfusion-tissue," the cells of this being characterised by the presence in their walls of small "pits" or apertures surrounded by a thickened border (bordered pits). This tissue is functional in permitting of the passage of water from the xylem of the bundles through the endodermis into the mesophyll of the leaf, and it also acts in aiding the downward translocation of elaborated food from the leaf-cells into the phloem portion of the bundles, which lies towards the flat side of the leaf (see fig.). The vascular bundles are here two in number, and are derived from the quadripartition of the bundles of the original central cylinder in the branch of limited growth from which the two leaves arise; and in such a case it is easy to see that the transfusion tissue is a tissue which has arisen to fulfil the conditions for adequate transpiration and conduction of raw and elaborated food substances. The mesophyll cells of *Pinus* are peculiar in possessing infoldings of their walls which in the adult cell form "trabeculæ," functional in increasing the available transpiring surface of the cell; intercellular air-spaces are present amongst these cells, but are relatively smaller in this case than they are in the bifacial leaf, and at the same time the total external surface of the leaf available for transpiration is, per unit of sectional area of the leaf, smaller than that which obtains in the

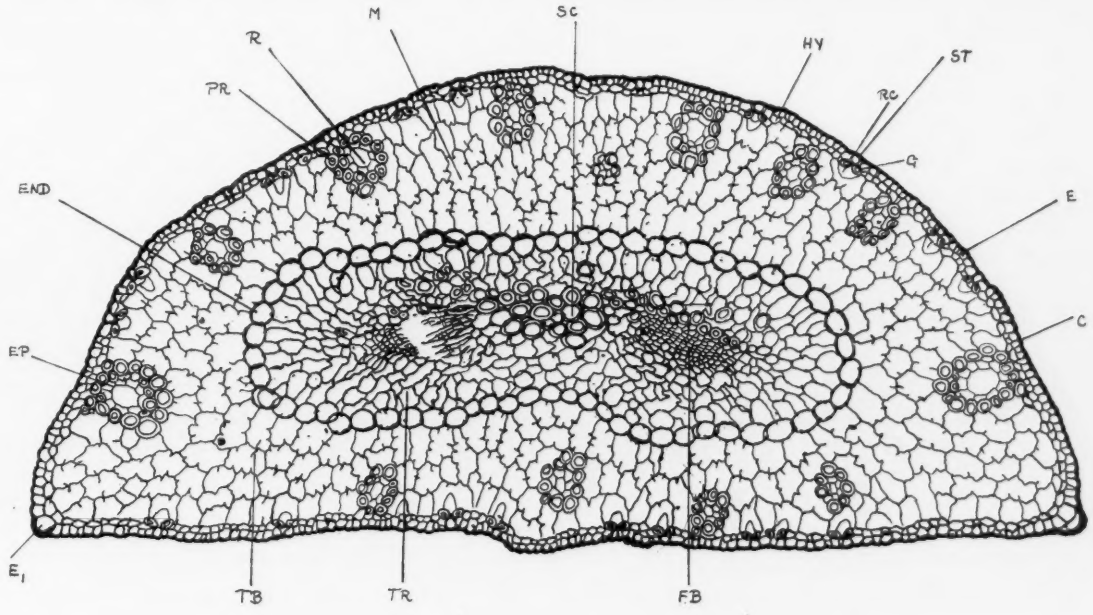


**Fig. 2.—A transverse section across the centric leaf of *Pinus*. (*Photomicrograph.*)**

| | | |
|---|---|---|
| E. Epidermis. | HY. Hypodermis. | END. Endodermis forming outer boundary of central cylinder. |
| C. Cuticle. | M. Mesophyll. | TB. Trabeculæ of cell of mesophyll. |
| ST. Stoma. | R. Resin-canal. | TR. Transfusion tissue. |
| G. Guard-cells. | P.R. Protective cells of resin-canal. | FB. Fibrovascular bundles. |
| R.C. Respiratory cavity. | E.P. Endothelial layer of resin-canal. | SC. Sclerenchyma. |

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bifacial type. As a rule, stomata exist in fairly large numbers, but their respiratory cavities are small, and the epidermis usually has just internal to it a layer of cells, which are very thick-walled and constitute the hypodermis; as a result of these two factors, the centric leaf of *Pinus* can withstand a drought better than many bifacial leaves.

Another point in which the leaf of *Pinus* resembles the stem of the same plant is in the possession of numerous "resin-canals" which lie in the mesophyll quite close to the hypodermis; these canals are continuations of those of the branch of limited growth, and ultimately of the main stem.

If, then, we compare the two types of leaf met with in higher plants, viz., the bifacial and the centric, it seems that of the two we shall find the bifacial to be the more highly differentiated; that is, it departs more from the type of axial organ than the centric, the latter showing, as has been seen, a distinct similarity in structure to the stem. Moreover, the vascular bundles in the centric leaf of *Pinus* are comparable to the undivided collateral bundles found in the stem, while the leaf-traces of a bifacial leaf are the result of the splitting up of a number of small cauline bundles of a petiole where such a portion is present; in other words, in the actual morphology of the leaf the bifacial type arises more as a new structure from an axis, whereas the centric type is often the result of the bi-, tri-, or multi-partition of that axis.

In certain members of the Gymnospermæ, viz., the Ginkgoales, the leaf takes the bifacial type, although the largest group, the Coniferæ, is characterised by the presence of the centric type; in point of evolution Ginkgo stands lower in the scale than the Conifers, so that we cannot always judge the position of a plant from the mere structure of its foliar organs; as a matter of fact, it is more rational to look upon the modifications of structure which arise in different organs as attempts on the part of the plant to cope with external surrounding conditions, than to assume that those modifications are the result of any inherent capacity. And it will in many cases be found that any changes which may have arisen will have had the effect of either modifying the distribution or the intrinsic structure of the component elements of those most important tissues in the leaf, viz., the $CO_2$, assimilating and transpiratory tissues. Modifications of the leaf which lead to the formation of such organs as the fly-catching structures of *Drosera* or *Nepenthes* (a "pitcher-plant") are, of course, also variations which arise to cope with external conditions, but, as a rule, they are accessory modifications, the green assimilating tissues and transpiratory parenchyma being always present, either in the same organ, or else in foliar organs on the same plant, having the typical structure of a bifacial or centric leaf. In the majority of instances, as a matter of fact, these accessory modifications are developed in connection with the need of the plant for a more liberal supply of nitrogenous food; it is only the chlorophyll-containing tissue which can assimilate carbon-dioxide from the atmosphere, and as such must be present apart from any modifications which may arise in connection with the absorption of nitrogen.

It is noteworthy that in some cases green foliar organs may be suppressed altogether, as is seen in the case of certain of the Cactaceæ, which are highly succulent plants, upon the tissues of which any undue loss of water by transpiration would be distinctly harmful; assimilation then proceeds in the outermost chlorophyll-containing cells of the main axis and transpiration is reduced to a minimum by a reduction in the area exposed and of the number of stomata per unit of area.

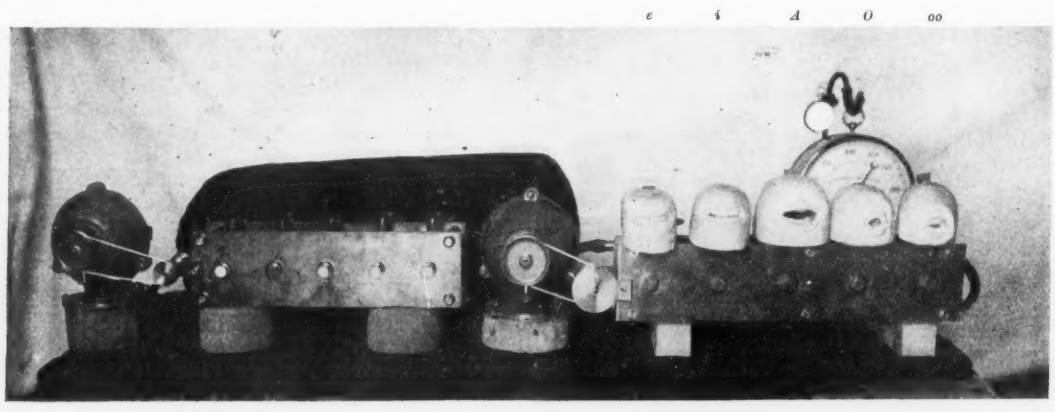
## A New Method of Training Deaf-Mutes.

By Dr. ALFRED GRADENWITZ.

HEARING, apart from the attending psychical phenomena, is a function intended to transmit to the acoustical nerve, in a transformed or unaltered condition, the sound vibrations produced in a solid, liquid, or gaseous medium. This function takes place more or less satisfactorily, and on its degree of perfection depends the sharpness of hearing.

By constructing an apparatus allowing all kinds of sound vibrations similar to those striking the ear to be produced under given conditions and with graduated intensity, the sharpness of hearing could obviously be tested and the ear of deaf persons—so-called—could be trained gradually. In fact, recent investigations have shown most deaf-mutes to be only partially deaf, their ear being susceptible of training by the production of conveniently graduated sounds. The only drawback met in this connection had been that no apparatus imitating the vibrations of speech with adjustable intensity was so far available.

In order fully to appreciate this distinction between the sound-vibrations of speech and those of noises or musical sounds, it should be understood that the former




**Dr. Marage's apparatus for sounding vowels.**

are far more complex than any sound vibrations produced by artificial means. While the organ of speech —the larynx—gives out periodically regular and intermittent vibrations producing the vowels, these are complicated by other sounds produced by the nose, mouth, and all kinds of membranes which impart to each voice its characteristic timbre. The fundamental vibrations forming the vowels are in no way connected with noises or simple vibrations such as those produced by a tuning fork or any similar apparatus. All these instruments accordingly can yield no information as to the manner in which speech is perceived. Moreover, the voice of the experimenter, which is most commonly employed as acoustic gauge, cannot be varied at will as to its timbre, pitch, and intensity.

In order to overcome those difficulties, Dr. Marage, of Paris, has constructed an ingenious apparatus, represented in Fig. 1, which is made up of five sirens, producing the fundamental vibrations of the vowels a, é, i, o, ou (as in French). Each siren is an artificial larynx, the opening of which imitates the position of the mouth in pronouncing the vowel in question. A stream of air which is thrown through this artificial organ of speech accurately imitates the sound in question. As all the sirens are actuated by the same electro-motor, the timbre in a given apparatus is absolutely constant.

This apparatus allows the pitch to be varied at will and to be determined at any moment by varying the speed of the motor with the aid of a rheostat. Furthermore, it enables the intensity to be controlled by varying the pressure of the air traversing the apparatus. In fact, the intensity of the sound depends on the pressure, which is measured by means of an extremely sensitive manometer. The instrument thus supplies sounds of constant timbre with variable and readily measurable pitches and intensities.

In order now to gauge the sharpness of hearing in a given subject, the ear to be tested is placed at a constant distance (say, 1½ feet) from the instrument and the intensity of the sound is augmented by increasing the pressure of the stream of air until the subject begins to hear the sound vibrations.

The sound produced under the pressure of 1 millimetre is well perceived by a normal ear; if the pressure for another ear has to be raised to, say, 40 millimetres in order to make the sound audible, Dr. Marage says that the sharpness of hearing of that subject is 1-40th; if to 60, 1-60th; if to 200, 1-200th, and so forth, thus obtaining a well-determined scale of hearing.

As pointed out in the beginning, it is only in exceptional cases that deaf-mutes possess absolutely no trace of hearing. However, the degree of acuteness is extremely variable. In the case of congenital deafness, in distinction to that normally observed, dull sounds are frequently heard far more easily than sharp sounds. Again, patients suffering from acquired deaf-muteness due to lesions of the middle ear hear the vowels o and a (French) best, and it is very important to gauge not only the degree but the quality of hearing by means of the siren in order to ascertain the best course for developing the sense of hearing by means of acoustical exercises.

In a similar manner as children are taught to read by beginning with the alphabet, the sense of hearing in deaf-mutes can be developed not by the complex and variable vibrations of a natural voice, but by the simple and well-determined vibrations of the vowel siren. As observed by Dr. Marage, this process goes on rapidly, without any fatigue either to the patient or to the operator, excellent results being obtained even in a few months.

## Photography: Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S., &c.

**Playertype.** The method of printing that Mr. Fournier d'Albe recently published in the Proceedings of the Royal Dublin Society, and that was referred to at length by Mr. Shillington Scales in the "Microscopy" section last month, quoting from the Journal of the Royal Microscopical Society, and stated to be new, is really very far from new. It has been fairly well known for many years as "Playertype," after the name of the inventor. Mr. J. Hort Player described this method in 1896, and an account of it will be found in the Journal of the Camera Club for December of that year. He published further notes on the method in the Journal of the Camera Club for 1898 (p. 33), and in the Journal of the Royal Photographic Society for January, 1903. Mr. Player died nearly two years ago, at seventy-eight years of age. So far as priority is concerned, it will be of interest to quote from a letter he wrote to me in 1901: "I may add that I am inclined to think from enquiry made in 1897 that something of the same kind had already been done in France, as I came across in *La Nature*, of, I believe, 1890, a casual reference to the possibility of thus obtaining a picture on bromide paper; it was, however, evidently not known of by a French expert who wrote me in 1896."

The advantage of the method is that book illustrations, letterpress, pencil drawings, silver prints, etc., may be copied, irrespective of printing on the other side of the paper, or mounted prints without unmounting them. Shortly, the process is carried out by placing the sensitive paper face downwards on the original, exposing through the sensitive paper, developing to get a negative, and then making a print from the negative. Mr. Player tried a great many variations in order to perfect the process. The first exposure, that is, the exposure for getting the negative, was always made through a coloured screen, at first green (pot-green glass), afterwards yellow. After trying many developers he preferred

| | |
|---|---|
| Hydroquinone ... ... ... | 2 grains. |
| Sodium sulphite ... ... .. | 4 ,, |
| Sodium hydrate ... ... ... | 2¼ ,, |
| Potassium bromide ... ... | 2 ,, |
| Water to ... ... ... | 1 ounce. |

He used gaslight, and afterwards found chloro-bromide papers better than bromide papers for getting the negative. After many failures, he succeeded in using daylight for the exposure, and the following quotation is from what I believe to be his last published instructions. He made the yellow screen by dissolving five grains of picric acid in sixteen ounces of boiled water, adding five drops of hydrochloric acid, using a layer of this solution about one-sixteenth of an inch thick, held in a cell made of two sheets of plate glass cemented together at the edges.

"To use the screen to copy, say, an engraving in a book, I lay the open book on a tray; between its leaves, immediately beneath the engraving, I insert a sheet of glass, and upon the engraving I place film downwards a sheet of 'Gravura,' 'Velox,' or other gelatino-chloride paper, and on the top of the paper I lay the screen, adding if necessary to its weight by superimposing a sheet of plate glass. Exposure may now be made to open and full daylight. . . . A good

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negative may be obtained in thirty seconds, or it may be necessary to expose for some minutes. I prefer hydroquinone as a developer, and use a solution containing three grains to the ounce, adding from a pipette as required a strong solution of caustic soda. The developed negative may be fixed, washed, and dried in the usual way. The negative picture obtained will usually be visible only by transmitted light, and the time required to print from it by full daylight on to 'Gravura' paper should be about thirty seconds. To develop positives I use the same hydroquinone developer, having added to each fluid ounce from one to two grains of potassium iodide."

I have an original print, with a negative and silver print made from it by Mr. Hort Player that he gave me about nine years ago. The negative is nothing like so much fogged as one might have expected; its detail is clearly visible as it lies on the table in even a poor light. The silver print is excellent, pure whites and good blacks, but it is not so sharp as the original, and although sharpness has been mentioned as a characteristic of the results obtained by such methods, I think it exceedingly doubtful if a degradation of sharpness will ever be avoided. So far as the principles of the process are concerned it is obvious that every detail is such as to give great contrast. Yellow light gives a steeper gradation than blue or white, hence the use of the yellow screen and the getting of better results with gaslight than daylight. "Gaslight" papers give steeper gradation than bromide papers, and hydroquinone and caustic alkali is a very "hard" or contrast-giving developer. Although the method seems to offer many advantages it has been very little used.

**Bichromated Gelatine.**

There have been many methods proposed for the development of carbon prints, that is, the dissolving away of the bichromated gelatine that has not been acted on by light during the exposure under the negative. L. Jacobsohn has secured a patent in Germany for a new process that may be found to have important advantages. By artificial "digestion" he dissolves away in the cold the unacted on gelatine. Water that contains, say, 1 per cent. of pepsin and 1½ per cent. of hydrochloric acid, will at 25° C. develop a print in about three hours. It is claimed that the action being slower than usual gives superior half tones. It seems not unlikely that so prolonged a soaking in weak acid would tend towards the reticulation of the gelatine, especially in the presence of a destructive agent like pepsin, but this is a matter that only experience can decide.

Professor R. Namias has found that exposed bichromated gelatine, which is known to resist the attack of so many reagents, is also able to resist the action of dry heat which shrinks plane gelatine, and that this action is so certain and definite that it may be employed practically for the getting of reliefs. It is a much quicker process than development by hot water, which dissolves away the parts not acted on by light, though the relief is not so great. The exposed plate is merely rotated in a whirler over a suitable flame until the shrinkage has been observed in all parts except those that represent the deepest shadows, taking care not to burn the gelatine. Such reliefs, being permanent, may be utilised at any future time for getting impressions or casts of the subject.

**Received.**

The "Wellcome Exposure Record and Diary," published by Messrs. Burroughs Wellcome and Co. at 1s., though a conveniently small pocket book, contains ample room for the details of six or seven hundred negatives, many pages for details of prints, memoranda, etc., and a diary of quite useful dimensions. In addition, there is a great deal of photographic information, concisely given, of just that kind that the amateur and general worker needs, and the Wellcome Exposure Calculator. The convenience of the user is studied to the minutest detail. This book has been published for many years, and well deserves the large measure of appreciation that it enjoys.

## Solar Disturbances During November, 1909.

By FRANK C. DENNETT.

THERE has been maintained a considerable amount of activity upon the Sun's surface right through November. On the 1st, at noon, the longitude of the central meridian was 155° 55′.

Nos. 118, 120, 121, and 122 again appear upon our chart, as they remained visible during the early days of the month.

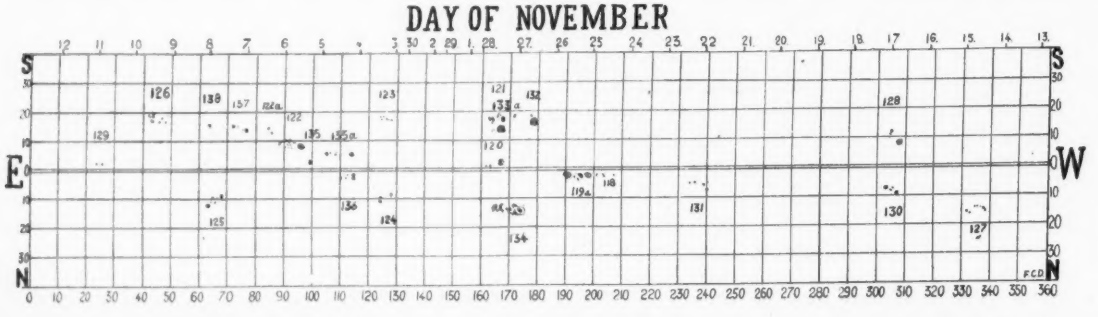
No. 119*a*.—A group with its leader 15,000 miles in diameter, and a length of 75,000 miles, seen upon 1st-2nd, but not again observed. There appears to be a possibility of a confusion between this group and No. 118.

No. 122*a*.—Two or three tiny pores seen south-east of 122, 5th to 7th.

No. 123.—An oval group of pores 4-5th; two elongated pores 6-7th; and a group of three in diagonal line, in a faculic area, 8-9th. The group 32,000 miles long.

No. 124.—Two larger and two or three smaller pores on 5th; an elongated triangle 33,000 miles in length 6th; one pore 7-8th, its site being marked by facula on 9th.

No. 125.—Two spotlets separated by about 24,000 miles on 5th, other pores opening between them. By 7th the first and last had enlarged whilst the length of the



group had increased to 60,000 miles. Notwithstanding its nearness to the central meridian faculæ were visible in the group. Only two pores remained until 10th.

No. 126.—A little group of pores on 5th, amid a faculic disturbance. Next day its length reached 58,000 miles, but quickly began shrinking until last seen on 11th.

No. 127.—A group of pores, partially outlining an ellipse whose major axis was 50,000 miles, only seen 12-15th.

No. 128.—A spot 16,000 miles in diameter, with a follower 52,000 miles distant. The larger spot was seen 12th-22nd, the smaller 12-20th, the latter had pores close around it 16-17th.

No. 129.—Pores 15,000 miles apart seen 14-16th.

No. 130.—A group of pores 30,000 miles long on 16th, increasing to 48,000 miles by next day. The leader enlarged, but the pores between it and the trail end dwindled. By 22nd only the leader remained, and that was not seen after.

No. 131.—On 19th only a pair of pores 22,500 miles apart, others developed, and on 21st and 22nd had a semi-elliptical form 60,000 miles in length. The largest member having a diameter of 10,000 miles on 23rd and 24th. On 24th only the eastern and western spots remained, and these not after 25th.

No. 132.—A fine spot visible from 21st until December 4th, with a diameter of 19,000 miles. The umbra crossed by a bright bridge 24th, and on 23-24th a pore was south-east.

No. 132*a*.—A spotlet 58,000 miles in the rear of the last, only seen 23rd.

No. 133.—A spot seen from 21st until December 4th, but 22,000 miles in diameter. On 28th its northern penumbra extended itself eastward to 32,000 miles. A bright bridge crossed its umbra. On and after 23rd an active group of pores and penumbral spots reached 45,000 miles towards south-east; this reached its maximum enlargement on 27th, decreasing after. No companions seen December 3rd-4th.

No. 134.—A group of pores 48,000 miles in length on 24th. By 27th the length had increased to 84,000 miles, several pores having much enlarged. By 30th the leader attained a diameter of 30,000 miles, and the trailer was a considerable spot. When close within the limb, on 4th, it remained a fine group.

No. 135.—A spotlet in a faculic district on 27th, divided 30th, two pores remaining on December 3rd and 5th.

No. 135*a*.—A spotlet, with pores following, showed on 29th, reaching 67,000 miles in length on 30th. A larger pore with minute companions near 3rd and 4th; one pore amid faculæ remaining 5-6th.

No. 136.—On 30th a double spotlet as leader with pores extending eastward for 57,000 miles. By 3rd only a solitary pore. November 29th to December 4th.

No. 137.—Two spotlets 51,000 miles apart with pores near on 30th. The leader rapidly increased to 14,000 miles in diameter, and on 5th the length of the group had grown to 85,000. Cloud afterwards seriously hindered observation, but on 9th a line of three pores were observed diagonally crossing this area near longitude 72°.

No. 138.—On 30th a solitary pore appeared in a faculic bed. Two were seen December 3rd, and until 6th when last observed.

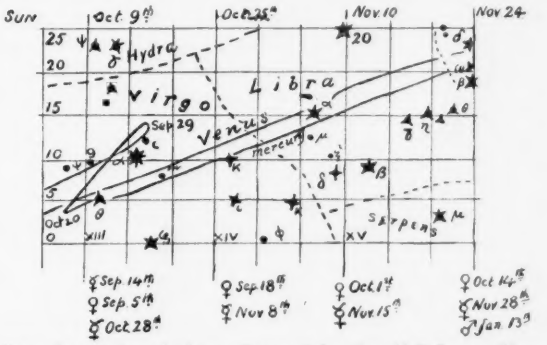
The chart is constructed from the combined observations of Messrs. J. McHarg, A. A. Buss, E. E. Peacock, W. Strachan, and the writer.

## Some Naked-Eye Observations of Mercury and Other Planets in Southern Tasmania.

By BERNARD THOMAS, M.B., C.M.

IN this part of the world, situated about 43° S., Mercury is not a difficult object to detect at certain elongations. This not only because of the elevation of the planet above the horizon when in southerly declinations, but also because of the clearness of the atmosphere and the usual absence of heavy clouds in the west in the evening or the east in the morning. Last year, in September, as an evening star he was easily detected, and this year it has been the same, when you know where to look for him.

In order to be successful the positions of the brighter stars should be known, for a 1st magnitude star, such as Spica, Aldebaran, or Pollux, might otherwise be mistaken for him. On the other hand, his position relative to these or any of the planets acts as a guide for his detection. A good star map showing the stars of the year is very useful and should be well studied. The pathway of Mercury and other planets can then be traced, and for this purpose it is a good plan to make one's own star maps of the zodiac somewhat




after the style of those figured in the "Science Year Book" of last year. The plan adopted is here reproduced on a small scale, though for clearness it is better to make the map larger.

At the top the sun's meridian is marked, and this enables anyone to tell at a glance the relation of the planet to the sun. Below the right ascension of the planets are marked and their relations whether north or south of each other. Of course, these maps do not pretend to any great accuracy, as they are only intended for naked eye observation. After drawing them on not too opaque white paper they can be printed by the usual method on blue photographic paper.

A very interesting phenomenon here was the conjunction of Venus and Jupiter on August 12. Venus was only 12′ north of the other planet and appeared just below him—the two brilliant bodies—twin stars apparently linked together—floating in space. They formed a most beautiful sight, and many wondered what such an unusual occurrence could portend. Rumours were rife at this time of airships—from Germany or other places—which were hovering over this peaceful land with dire intent. To those who knew the heavens and watched them nightly it was of great interest to notice from day to day how they approached one another, met, and passed.

It was while watching these two planets, now several degrees apart, that on August 23 at 6.15 p.m. I caught

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the first glimpse of Mercury about 24 days before his greatest easterly elongation. I watched him each evening after that, when it was fine, and had sight of him on 14 evenings till the 16th, when he was 27° 26′ from the sun. On the 25th he was in conjunction with Jupiter, but here more than the diameter of the moon separated the two (☿ 40′ S.). In a few days Jupiter became lost in the sun's rays, while Mercury got brighter, set later, and moved in the direction of Venus. The changing relations of Venus, Mercury, and the bright star Spica (α Virginis) were interesting to watch.

On September 3 I took my first record on a photographic plate of Mercury. This was done by giving an exposure of 2½ minutes with a fast plate (Imperial Flashlight) and developing with paramidophenol.

Planets and bright stars appear as streaks, while any flaw in the plate or dust speck which may happen to get there is easily eliminated. Moreover, the angle of direction with the horizon is always the same. (It occurs to me that this might be a good way of getting one's latitude.)

**September 18, 1909, at 7 p.m.**

The photos here reproduced will explain themselves; one must look closely, however, for the image of Mercury. The negatives held up to the light really show his position better, and the change of position can be accurately determined by measurement or by superimposing the negatives.

The last photographs taken introduce the moon, with which Mercury was in conjunction on the morning of the 17th (16th G.M.T.). The day before the moon was not far off, and the silver crescent, just about 41 hours old, could be seen just setting when Mercury was visible. No doubt the interesting little planet will be visible for a few more days, but here we will leave him for the present.

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FRENCH colonial authorities have inaugurated a serious attempt to introduce in the French market the zebu of Madagascar as a substitute for beef. The first batch of a dozen carcasses sold in the Paris stalls brought the prices of the highest grades of cattle. Herds of zebus, otherwise known as Indian oxen, which have been threatened with extermination, are now being rapidly restored, and probably 4,500,000 head roam the plateaus of Madagascar. The meat of the zebu is said to be savoury and nutritious, and is equal to beef.

## The Constancy of the Bee.

By G. W. BULMAN, M.A., B.Sc.

II.

GLANCING through a recently published work, entitled "The Nature Book," we came across an article on bees and their ways, containing the following statement:—

"Once visiting a flower a bee will go to no other variety until it has returned to the hive to deposit its honey and remove the pollen that has adhered to it. This instinct is one of Nature's provisions for the prevention of pollen from one variety of flower being carried to another, and of insuring the fertilisation of the flower."

A few days later we were sitting in a garden near a bed of flowers containing lobelia, heliotrope, mignonette, and calceolaria. A good many hive bees, and an occasional humble bee, were busy among the various blossoms. Fixing our attention on the former we saw five pass from lobelia to heliotrope, and six from heliotrope to lobelia in the course of a short time. Here, again, is an extract from notes made on the hive bee in a garden among the early spring flowers. In the course of about an hour and a half ten bees were seen to change from one species to another.

No. 1 from Chionodoxa to Crocus.
,, 2 from Dog Violet to Hepatica.
,, 3 from Crocus to Chionodoxa.
,, 4 from Hepatica to Chionodoxa.
,, 5 from Crocus to Chionodoxa.
,, 6 from Hepatica to Chionodoxa.
,, 7 from Hepatica to Chionodoxa.
,, 8 from Chionodoxa to Hepatica.
,, 9 from Hepatica to Chionodoxa.
,, 10 from Crocus to Scilla.

Again, looking up some old notes we find records of hive bees going from lavender to wild geranium, willow herb, snapdragon, evening primrose, and Lycesteria formosa.

And yet the hive bee is much more constant in its visits to flowers than many species of wild bees. Professor F. Plateau, of Ghent, who has spent much time in observing the ways of bees with regard to flowers, says that the species of humble bees are "very inconstant." Here are a few examples from our own notes by way of illustration:—A small humble bee was kept in view while it visited 27 blossoms, and was seen to change from one species to another 10 times. And another wild bee was seen to make 11 changes in visiting 45 blossoms. A small worker of some species of Bombus, again, gathering nectar in a hay-field, was seen to visit flowers of such diverse forms as red and white clover, knapweed, self-heal, and bird's-foot trefoil. It was seen to visit 34 heads of flowers, and changed its species 10 times.

And at times in walking along the road when we have not time or inclination to watch a bee for long we note facts of the following nature:—

A humble bee goes from herb robert to wild strawberry. Another on hedge parsley goes to meadow sweet. A worker of a species of Bombus, after visiting several bramble flowers, goes to slender-flowered thistle. Another wild bee is seen to go from white hemp nettle to bramble, and yet another from this nettle to vetch and then to bramble. Such are a few examples of the frequent inconstancy of our wild bees such as can be observed by any country rambler.

As regards the second part of the above statement,

that the constancy of the bee is a provision of Nature to prevent the pollen from one variety of flower being carried to another, we may note that Darwin found the easily recognised pollen of the evening primrose on the stigmas of a number of different flowers. And he inferred that this was the work of the bees. And those who watch carefully the ways of bees may not infrequently see them with thighs laden with pollen of a different colour to that of the flower they are visiting. Thus we have seen them with loads of dark orange pollen busy on the greenish flowers of the asparagus. Again, we have seen bees carrying fragments of the filamentous pollen of the evening primrose visiting fuchsias and other flowers. On other occasions we have seen them dusted with the whitish pollen of the hollyhock working the flowers of species of linaria.

The constancy of the bee has for long been a favourite belief among naturalists. More than 2,000 years ago Aristotle wrote :—

"During each flight the bee does not settle upon flowers of different kinds, but flies, as it were, from violet to violet, and touches no other species till it returns to the hive."

It is but justice, however, to the great naturalist of ancient Greece to say that this statement probably referred only to the hive bee, and was not intended to include the more erratic humble bee. Darwin, after quoting Aristotle, expressed his own opinion thus :—

"All kinds of bees and certain other insects usually visit the flowers of the same species as long as they can before going to another species."

According to H. Müller, "The most specialised, and especially the gregarious bees, have produced great differentiations in colour, which enable them on their journeys to keep to a single species of flower." And Lord Avebury states that it is "a remarkable fact that in most cases bees confine themselves in each journey to a single species of plant." Dr. A. R. Wallace, again, tells us that "It has been ascertained by several observers that many insects, bees especially, keep to one kind of flower at a time, visiting hundreds of blossoms in succession, and passing over other species that may be mixed with them."

It is, in fact, a widely accepted belief that, as a rule, a bee visits only one species of flower in a single journey. And the assumption that this is so is one of the foundation stones of the theory of the evolution of flowers by the selective action of insects.

What strikes us most, perhaps, in the assertions quoted above, is their unblushing audacity. Even if a bee did always keep to one kind of flower in a single journey, how could anyone prove it? Has anyone ever kept a bee in view from the time it left the hive or nest till its return? No one, we venture to think, who has tried to keep a bee in view as long as possible will believe that this has ever been done. Not a single bee, it may be confidently asserted, has ever been proved to have returned to the hive without having visited more than one species of flower. Yet we have seen there are a number of very definite statements that it usually does so passing current as science.

The publication of the new catalogue of Messrs. Flatters and Garnett's (of Manchester) lantern slides is evidence not merely of their competence to cover the field of microscopy in biology—zoology and botany—but of the widespread demand that there is for lantern slide diagrams throughout the whole range of pure and applied science. The slides enumerated embrace geology, astronomy, physiography, textile fibres and machinery, metallurgy, physics and chemistry; and there are sections almost as large dealing with less specialised departments of interest, such as scenery and views of little known and well known places. A special feature of the catalogue is its clearness of arrangement and its admirable index.

## Numbering the Stars.

By F. W. HENKEL, B.A., F.R.A.S.

IN all ages one's first impression as to the number of the stars visible has been that this is beyond counting, and, in fact, the saying "as the sands of the seashore and the stars of the sky for number" has become a stereotyped expression for absolute countlessness. Yet in reality the number visible to the unaided eye even of the keenest-sighted observer is strictly limited. In the whole of the heavens not more than two or three thousand are visible at one time, and by far the larger number of these are very faint, visible only by glimpses on clear moonless nights, so that we may fairly say that not more than about a thousand or so could be seen distinctly enough to be properly observed, and have their positions registered before the invention of the telescope. This is, in fact, the number (1005) contained in Tycho Brahe's star catalogue of 1580, the last and most exact list made in pre-telescopic days. On the invention of that instrument and its application to Astronomy, exactly three centuries ago, the number of stars was enormously increased. Galileo's telescopes, not more powerful than a modern opera glass, showed at least 100,000 stars, and every increase in optical power has enlarged the number known to exist, so that for all we know their total number may be infinite, in the only sense in which we can attach a meaning to that term.

The great Lick Telescope reveals not less than 100 millions of these objects, many of them as large as or larger than our own Sun, some perhaps smaller, but others vastly greater in real dimensions, whilst the number visible in the Yerkes refractor and the giant reflectors of Lord Rosse and at Melbourne is greater still.

Catalogues or lists of the stars giving their positions and magnitudes from time to time have been formed, the earliest known one being that made by Hipparchus, who lived about 150 B.C. It is recorded that a new star having suddenly made its appearance in the sky, he was led to compile this list so that by comparison with it future generations might detect any changes either in position or in magnitude. His catalogue is not preserved in its original form, but was handed down to us by his successor, Ptolemy, the author of the famous *Almagest*, which for 1500 years was accepted as the standard authority in Astronomy. Another was made by the Persian astronomer Al Sufi in the 10th century, and five hundred years later appeared the catalogue of Ulugh Beigh, grandson of the famous Timur or Tamerlane, prepared from original observations. By comparison with Ptolemy's work he found that there were 27 stars recorded by Ptolemy which were too far south to be seen at Samarcand (where Ulugh Beigh's observatory was situated) and that eight others could not be found. As we have already mentioned, Tycho Brahe's catalogue was made in 1580, and a supplement containing a list of stars not visible in Northern latitudes was made by Halley (well known for his researches on the comet called by his name which has just been rediscovered), who made a journey to St. Helena in 1677 to observe them.

The number of modern catalogues of the stars is very considerable, almost every observatory having taken some part in preparing such. Catalogues of "precision," giving with the utmost accuracy the places of some hundreds of stars serving as "fundamental points" to which the positions of other stars, comets, planets, &c., may be referred, have been issued from time to time, those of our own National

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Observatory being perhaps the most exact of all. Under the auspices of the *Astronomische Gesellschaft*, an international society having its headquarters in Germany, there has been prepared a catalogue containing the places of all stars down to the ninth magnitude (practically all those visible in a good opera glass or small hand telescope).

A number of observatories all over the world have co-operated in the production of this work, and it is now nearly complete. Not less than 100,000 stars in all will thus have their places very accurately determined, all nearly for the same epoch, and by comparison with future catalogues much valuable information as to star changes will be obtained. But this catalogue is also to serve another purpose, to which we now turn. The operations involved in forming a catalogue are necessarily lengthy and somewhat operose. Every star has to be observed several times, its right ascension and declination (corresponding exactly with longitude and latitude of places on the Earth's surface) determined by measurements with the transit circle, and the observed places *reduced* by the appropriate corrections to a common epoch. About the middle of the nineteenth century, Argelander, as the result of vast labour on the part of himself and his assistants, published his famous *Durchmusterung*, giving the places of 324,000 stars of the Northern heavens, down to 2° South of the Celestial Equator. This work was extended by Schönfeld to include stars further South down to 22° from the Equator, and the *Uranometria Argentina* and Cordoba *Durchmusterung* continue this down to the South Pole. The places of the stars are not given with the same precision as in the fundamental catalogues above referred to, but serve as means of identification when used for observations of comets and minor planets, &c. It was, however, the successful application of photography in taking pictures of the great comet of 1882 at the Cape of Good Hope Observatory, that drew the attention of astronomers to this new method for cataloguing the stars. Photographs of the comet showed not only that object, but also telescopic stars down to the tenth magnitude, distinctly impressed on the plate. From this success arose the Cape Photographic *Durchmusterung*, and, indirectly, the Paris Astronomical Conference of 1887 and the Astrographic Catalogue of the Heavens. Sir David Gill and his assistants proceeded to photograph the Southern stars on a series of plates, and the positions of these were measured on glass reproductions by means of special measuring machines designed by himself. The photographs were mainly taken from 1887 to 1891, and the measurements of the positions and magnitude of about half a million stars were undertaken by Professor Kapteyn, of Groningen, and completed in 1899. Though intended as an extension of Argelander's work, the photographic *Durchmusterung* is much fuller than the latter, and the star places are more exactly determined. Meanwhile, a yet greater undertaking had been inaugurated. Dr. Gill in 1886 proposed an International Conference to consider the question of making a great photographic survey of the whole sky, to include all stars visible down to the 14th magnitude, and this led to a meeting at Paris in April of the following year. Fifty-six delegates from 17 different countries met together under the presidency of Admiral Mouchez, the Director of the Paris Observatory. It was resolved to photograph the whole sky upon glass plates about 10 inches square, each covering an area of four square degrees of the heavens. Two sets of plates were to be taken, one giving stars down to the 14th magnitude, another set, of much shorter exposure, giving all stars to the 11th magnitude. The number of the former stars was estimated at about 20 millions, that of the latter, from which a catalogue was to be prepared, about a million and a quarter. Eighteen observatories agreed to take part in the work, and all the plates were to be taken with similar telescopes having object glasses of apertures 13 inches and focal length 11 feet, on the model of the photographic refractor used by the brothers Henry, who had so successfully photographed the Pleiades group and detected new and hitherto unsuspected nebulosities surrounding the latter. The object glasses were to be specially corrected for the "actinic" rays, and a guiding telescope of somewhat smaller dimensions was attached to each instrument, so that the observer could watch the position of the star images during the operation and adjust the apparatus in the event of any shift or disturbance. It was originally intended to give each plate an hour's exposure, but improvements in the sensitiveness of the plates enabled that time to be considerably shortened. About 11,000 plates of this size are necessary to cover the whole sky, and since each star must appear at least on two plates, the whole number, allowing for overlaps, is about 22,000. Every plate contains a number of previously catalogued stars whose position is well determined, and so by comparison with these the position of all the other stars may be determined with accuracy. Owing to the great richness of stars near the Milky Way and the increased sensitiveness of the photographic plates, it seems probable that the original estimate of 20 million stars will be largely exceeded, and that double that number will be photographed when the work is complete. It was originally hoped that this would have been finished within five years or so from the time of starting, but delays, some unexpected and others not so, have arisen, and the period of 20 years sees it still unfinished. It is now, however, approaching completion, some backward Observatories having fallen out and been replaced by others. Greenwich and Oxford have already published the greater part of their zones (Greenwich, Dec. 65° N. to the pole; Oxford, Dec. 25° to 31° N.), and others are far advanced. The zone 40° to 52° S. allotted to the Cape Observatory was started in 1893, and by the end of 1897 the required number of 1512 catalogue plates had been obtained and nearly half the chart plates, whilst in the following year it was decided to re-photograph the whole zone to bring the epoch at which the plates were taken nearer to that of the comparison stars. In 1900 Sir David Gill undertook to photograph the area within 2° of the South Pole, originally allotted to the Melbourne Observatory. Meanwhile the measurement of the plates, commenced in 1898 by the aid of a special machine designed by Sir David Gill, is now nearly completed, rectangular co-ordinates for 1173 plates having been completed, reduced, and checked by the end of 1908. The work at Greenwich and Oxford is in an equally advanced state. Though it has been the idea of some astronomers that the place of every star in the sky shown in these plates should be given in the ordinary co-ordinates, Right Ascension, and Declination, corresponding, as we have said, exactly to longitude and latitude of positions on the earth's surface, yet it has been found practically much simpler and equally exact to give what are called the rectangular co-ordinates of the star instead. The method was invented by Professor Turner in this connection, and is a great simplification, though not less exact than the other.

The centre of a plate is taken as the origin of co-ordinates, and two mutually perpendicular axes, the axis of $x$ and the axis of $y$ start from this point, the distance "$x$" being, as usual, measured horizontally right and left, "$y$" being the distance vertically upwards or downwards according to the ordinary convention—$x$, + to right, − to left; $y$, + upwards, − downwards.

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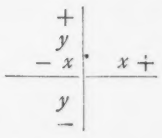


Every plate is covered with a network or *réseau* of horizontal and vertical lines and the distance of each star in terms of *réseau* intervals, and its photographic magnitude, are determined. The plate is placed in a measuring machine, which is a framework having a horizontal and vertical scale; also a reading microscope with scales or screws to measure fractions of a *réseau* interval. It has been found that, in this way, by taking the means of measures made when the plate is placed in one position, and then turned round through 180°—*i.e.*, reversed—the place of a star may be determined to an accuracy of less than $\frac{1}{10}$ second of arc. At Helsingfors, the places of the stars are being all reduced to the ordinary co-ordinates of Right Ascension and Declination, but this heroic piece of work seems unnecessary in view of the results obtained elsewhere. The Astronomische Gesellschaft catalogue is all but completed, and it can be but rarely that the equatorial co-ordinates of any other stars will be wanted, the "rectangular" co-ordinates giving all required information when the Right Ascension and Declination of the plate centre is known. By repeating the work later on it will be possible, by comparison of the newer photographs with those of the same region of the sky taken now, to collect a great mass of information as to changes of position and magnitude, "proper motions," variable stars, new stars that have appeared in the interval between the earlier and the later photographs, old stars that have disappeared, &c., and thus lay the foundation of a rational system of stellar astronomy. Already a few results of value have been obtained. Professor Kapteyn, examining photographs of stars made at the Cape Observatory, found the impression of a star of the 8th magnitude which was not contained in any catalogue. Examining different photographs it became evident that the star had been previously photographed, but always in a different position. Thus it was ascertained that this star had a more rapid "proper motion" (motion peculiar to the star after allowing for precession, nutation, &c.) than any other previously known, nearly 9 seconds of arc per annum, or $\frac{1}{4}$th greater than that of the well-known 1830 Groombridge, sometimes called the "runaway star." Even so, this star would require nearly 150,000 years to make the circuit of the heavens moving at its present rate of angular progression. Since this motion is such that it could scarcely be detected by the unaided eye in the course of a lifetime, we may well use the expression the "fixed stars" knowing all the while that they are not fixed, but many of them are in motion which to our terrestrial notions is extremely rapid. Yet so vast is the distance of even the nearest of these objects from our system that many centuries must elapse before these motions produce much change in the relative positions of the stars, and the shape of the constellation figures. If it were possible for the early Chaldean astrologers of the plains of Shinar to revisit the scene of their labours, they would have no difficulty in recognising the old familiar constellations. Possibly they might notice a slight change in the positions of Arcturus and perhaps of Sirius, but no others. Halley was the first to notice that since the days of Ptolemy, Arcturus has moved about a degree (twice the apparent diameter of the Sun or Moon) and Sirius about half this amount (2″·1 and 1″·2 annually.)

Yet nothing can be more certain than this, that everywhere throughout the Universe the stars are in motion. Our Sun is in rapid motion towards a point not far from the direction of the bright star Vega; five of the seven stars of the Plough have a motion nearly the same in direction and amount; the well-known group of the Pleiades, almost as a whole, moves as a single mass with a common rate of about 7″ per century. Professor Lewis Boss finds thirty-nine stars in Taurus having proper motions accurately directed to a single point of the celestial sphere, forming a great "globular cluster" about 15° in diameter, having central condensation. In the course of revision of the astrographic work at Oxford new plates have been taken of certain regions of the sky where the number of stars on those already taken was less than was expected. These when measured are being compared with some of the earlier ones in the hope of detecting cases of proper motion, but so far the result has shown that large proper motions of faint stars are comparatively small. By means of the Astrographic Chart the materials for framing new and more reliable theories as to the nature of the connection between our Sun and other stars, whether the Milky Way and the other stars visible form one system, or two or more systems, or whether the whole is a "vast republic without any central authority," as the late Professor Young said, are being collected on a scale and with a precision hitherto unattainable.

Three centuries ago most men considered our little Earth to be the centre of the Universe, and it was long before this place was conceded to the Sun. Then Sir William Herschel showed that our Sun, too, is in motion, and only during the last century was it possible to say that vast though its dimensions are compared with all terrestrial standards, it is a mere "cadet" in the host of heaven. Mädler's supposition that Alcyone in the Pleiades is the central Sun around which the others revolve, though probably erroneous so far as our own case is concerned, at least leads to the idea of mighty bodies compared with which our Sun shrinks into insignificance.

If there be any relation between brightness and size, the stars Canopus, Rigel, and Deneb, must be many thousands of times larger than our luminary, whilst Sirius, Aldebaran, and Arcturus are each of them suns of great magnitude.

With the completion of the Astrographic Chart and catalogue it will be possible to do thoroughly for the whole sky what has hitherto been done only for selected regions, and a record of the present state of the heavens will be left as a legacy to all future generations.

## The Late Dr. Bowdler Sharpe.

NATURAL History has sustained a great loss by the death, at his residence at Chiswick, on Christmas Day, of Dr. Richard Bowdler Sharpe, the well-known ornithologist. Born in London on November 22, 1847, Dr. Sharpe began life with Messrs. W. H. Smith and Son, in 1863, later being with Mr. Bernard Quaritch, in 1865-66. Dr. Bowdler Sharpe's scientific career began in 1867 when, at the age of twenty, he became the first holder of the post of librarian to the Zoological Society of London. This he held for five years, and his work led to an invitation to join the staff of the British Museum, which he did in 1872, as senior assistant in the department of zoology. Dr. Sharpe had seen great changes in the Natural History Museum. When he entered it, the collection contained only 35,000 birds, whereas now the numbers have swollen to 400,000. The great debt which science owes to him is the Catalogue of Birds, begun in 1874 and finished in 1888. This monumental piece of work comprises twenty-seven volumes, and of these no fewer than thirteen were written by Dr. Sharpe himself.

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# NOTES.

## ASTRONOMY.

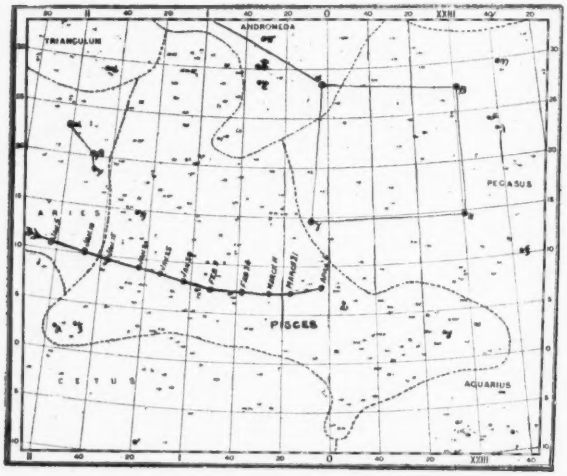
By CHARLES P. BUTLER, A.R.C.Sc. (Lond.), F.R.P.S., F.R.A.S.

**HALLEY'S COMET.**—The unusually good weather during November offered favourable opportunities for observation of this important comet. It is now steadily becoming more prominent; at times glimpses have been possible with as low as two inches aperture. Towards the end of November it was of about the tenth magnitude, showing quite distinct from neighbouring stars of equal brightness on account of its nebulous nature and very rapid motion. During the month it will travel westwards through Pisces, as indicated in the following ephemeris.

| Berlin Mean Time. | R.A. | Decl. | Log. $r$. Dist. from Sun. | Log. $\Delta$ Dist. from Earth. |
|---|---|---|---|---|
| 1909. Dec. 31·1 | 2h 21m 40s | + 11° 42′ | | |
| 1910. Jan. 5·1 | 2 4 24 | 10 56 | 0·2966 | 0·1570 |
| ,, 10·1 | 1 49 13 | 10 15 | —— | 0·1706 |
| ,, 15·1 | 1 36 1 | 9 39 | 0·2644 | 0·1853 |
| ,, 20·1 | 1 24 36 | 9 9 | —— | 0·2003 |
| ,, 25·1 | 1 14 46 | 8 45 | 0·2288 | 0·2149 |
| ,, 30·1 | 1 6 19 | 8 27 | —— | 0·2286 |

The ascending node of the comet's orbit is passed on 1910 January 17.9. The comet will be in conjunction with Mars on January 15, passing about 1° 10′ to the south of the planet. It is in conjunction with Saturn, January 28, passing 3° 48′ north.

At the last meeting of the Royal Astronomical Society it was announced that the comet had been detected on a plate exposed in the 30-inch Reynolds' reflector at Helwan, Upper Egypt, on August 24, 1909. On the plate taken on that date a marking was seen which, being near the computed place, was suspected to be a trace of the comet, and the plate was sent to Greenwich for further examination.




**Path of Hailey's Comet during 1910 January - April (A. C. D. Crommelin's ephemeris).**

After careful consideration it was concluded that it was indeed the comet, so that this ranks as the earliest recorded observation during the present apparition.

At the same meeting an interesting communication was made by an observer who saw the comet at its last appearance in 1835. He said it was at first a conspicuous object moving towards the north-west, with a short tail. Soon afterwards it shot out a longer tail. For those making arrangements to obtain photographs of the comet during the coming months the excellent article by Professor E. E. Barnard should prove a great help. It is replete with practical suggestions, dealing specially with selection of plates, method of development, avoidance of sky and moon fog, types of lenses, guiding arrangements, etc. It will be found in *Popular Astronomy*, No. 170.

**PHOTOGRAPHS OF MARS.**—With the perfecting of the 60-inch reflector by Mr. G. W. Ritchey at the Solar Observatory, Mount Wilson, Pasadena, California, the photography of the physical features of the planet has entered on a new phase. Some of the first results were shown at the meeting of the Royal Astronomical Society, and it was at once evident that they were far beyond anything that has been done before. On a large scale, with very regular outline, indicating perfect following, the details were practically as much as is seen during the best moments of definition under visual observation.

Several photographs of Mars obtained by M. Tikhoff at Pulkowa also excited considerable interest. Specially sensitised orthochromatic plates were employed, in conjunction with two-colour screens of different colour, one transmitting orange, yellow, and red, the other only greenish yellow. With the orange screen the region about Hellas, which is a conspicuously reddish region, was definitely brighter than the polar cap; with the green screen, however, the polar cap came out much brighter than the Hellas region. Such photographs indicate the extreme importance of recording carefully all details connected with the work, if results obtained at different stations are to be useful for comparison of the physical features of the planet.

**TERRESTRIAL EQUIVALENT OF COMET MOREHOUSE SPECTRUM.**—It will be remembered that the spectrum of Comet Morehouse of 1908 contained several conspicuous double bands, which, until recently, had not been recognised as due to any terrestrial substance. Professor A. Fowler has now obtained the whole series of bands, agreeing both as to intensity and position, by photographing the spectrum of a very highly exhausted vacuum tube. The work of tracing the elemental origin in such cases is very difficult, but by a process of gradual elimination it is concluded that the bands are due to some modification or compound of carbon.

**GROUPING OF STARS BY POSITION, MAGNITUDE, AND SPECTRUM.**—In a very thorough discussion of the Revised Harvard Photometry made at the Harvard College Observatory under the direction of Professor E. C. Pickering, a number of suggestive conclusions are reached concerning the laws of stellar distribution. In all, 9110 stars are included in the examination; these were divided into 48 groups according to their position in the sky, 6 groups according to magnitude, and 6 groups according to their spectral class. The details are too intricate to abstract in a short note, but several of the main results may be summarised. With respect to magnitude, most of the various catalogues combined in the discussion show a very satisfactory agreement as to scale, although they extend over a period of twenty-seven years. The general agreement as to colour values shows that, for stars in the same part of the sky, those having the same spectrum have the same colour. One of the most important definite results deals with the distribution of the various spectral types, as on several occasions the presence of an absorbing medium in space has been inferred from similar data. Grouping according to the Harvard system, the coefficient of distribution is found to be of such a value that there is no necessity to invoke the aid of an absorbing medium to satisfy the results; and, moreover, it is not probable that such a medium would affect stars of one class and not those of another. Any effect of selective absorption should be detected as a prominent dark band in very distant stars. Another notable fact is that the Milky Way exerts an influence on the distribution factors all over the sky, and not merely on a narrow zone corresponding to the hazy belt of stars seen by eye.

# BOTANY.

By G. MASSEE.

**SAND-DUNES IN NEW ZEALAND.**—Dr. Cockayne gives an interesting account of New Zealand sand-dunes, in an official report. The characteristic of a dune, as contrasted with a fixed hill, consists of its instability, due to the material of which it is composed, hence the facility with which the whole mass can be moved to a longer or shorter distance, according to the velocity of the wind. Dunes are most frequent along the sea coast, but some are also present inland. Owing to the inland movement of the coastal dunes, much valuable land has been lost, and the danger is yearly becoming more difficult to combat. The area now occupied by dunes is, roughly speaking, 290,000 acres in the North Island and 24,000 acres in the South Island. The dunes of western Wellington occupy an area of more than 90,000 acres, and extend for about 170 miles along the coast.

The formation of the sand of the dunes commences on mountain sides, where the action of frost, variations in temperature, etc., bring about disintegration of rocks; such broken up material is transported by rivers to the sea, which it reaches in various degrees of fineness varying from boulders to fine sand. A certain amount of sand is also directly due to the erosive action of the sea. Sand-grains of dunes are distinguished from ordinary river and sea sands in being thoroughly rounded, due to the rolling backwards and forwards in a dry state by wind.

The dune flora is remarkably uniform throughout New Zealand, owing to the soil factor proving to be of more importance than the climatic factor. The dunes of the Auckland Islands have a special flora of their own. Dune plants proper not only tolerate but benefit by a partial sand-burial, and are highly specialised, being characterised by their great length of stem. This enables them to spread over wide areas, and to increase rapidly by vegetative means under conditions which would be fatal to seedlings. Among the most important of such "sand-binders" are *Spinifex hirsutus*, a grass; *Scirpus frondosus*, a sedge; and *Euphorbia glauca*, a spurge. A few other plants usually present are of minor importance. It is very rare indeed that a dune in course of formation is quite destitute of plant-life; indeed, the majority owe their progress and existence to the presence of "sand-binding" plants, which in the first instance have stopped the sand drift, and assist further deposits to collect, while at the same time their own growth is accelerated, they and the sand rising up together. It is remarkable how scanty a plant covering checks the wind; even where tufts of grass or sedge are only a foot tall, and where more than two-thirds of the surface is unprotected, it is remarkably stable.

The author considers that, judging from the results obtained in Europe, the great bulk of the sand-dunes in New Zealand could be reclaimed. The final treatment of dunes should assuredly be afforestation.

**LATERAL ROOTS OF AMYELON RADICANS, WILL., AND THEIR MYCORHIZA.**—*Amyelon radicans* is a fossil plant found in the Coal-Measures, and in examining its structure, T. G. B. Osborn has detected the presence of mycorhiza in the lateral roots. The details are recorded in the *Annals of Botany*. The lateral roots are "bunched" or present the appearance of the "coralline roots" of many recent plants known to possess mycorhiza. The hyphæ of the fungus occur in the cells of the inner cortex; certain of the cells are filled with a tangled mass of hyphæ, in other cells the hyphæ appear to have been absorbed by the host plant, the indigestible residue being left, as is usually the case with recent plants. The fungus is absent from the cells composing the endodermis and from the growing region.

*Amyelon radicans*, the name originally given to the fossil under consideration, is now known to be the root of *Cordaites*, which was probably a tree inhabiting saline swamps, and having bunches of coralline rootlets on its roots, such as are known to occur in many recent plants growing under similar conditions.

**AGRICULTURE IN JAPAN.**—F. G. Carpenter gives an account of the status of agriculture in Japan, in the *Philippine Agric. Review*. The country is said to be kept like a garden, and it is as fat as the Valley of the Nile. Japan, including Formosa, has an area of 161,160 square miles; much of this, however, is mountainous, and only about 20,000 square miles is cultivated, yet this area feeds a population of 50,000,000. It produces every year 100,000,000 bushels of rye, wheat, and barley; nearly 100,000,000 pounds of tobacco, 56,000,000 pounds of tea, 10,000,000 bushels of silk cocoons, as well as buckwheat, millet, beans, indigo, cotton, and hemp. However, by far the most important crop is rice, which amounts to 250,000,000 bushels in the year, worth 40,000,000 pounds sterling.

The whole country is divided up into patches ranging in size from that of a bed-quilt up to an acre or so, and every bit is perfectly clean. There are no fences. The farms are, on an average, not more than two acres in size, and about half the land is worked by the owners. The most remarkable feature is the close or intensive cultivation practised, and the smallest details in the selection, planting, cultivation and harvesting of the various crops receive attention. The greater part of the rice crop is raised by irrigation. After the land has been prepared it is flooded. The rice plants are grown in nurseries, and are planted in the mud in rows of bunches of four to six plants each. They are planted so close together that it takes from 1,500 to 3,000 bunches per acre.

**LIBERATION OF OOSPHERES IN SARGASSUM.**—A preliminary note by M. Tahara in the Tokyo *Bot. Mag.* states that in about ten species of *Sargassum*, under observation at the Misaki Marine Biological Station, Tokyo, the liberation of oospheres is periodic, occurring in fortnightly crops on a certain day at a definite period after the highest spring tide. Oospheres are liberated from the same conceptacle for a period extending over two or three fortnightly crops.

# CHEMISTRY.

By C. AINSWORTH MITCHELL, B.A. (Oxon.), F.I.C.

**THE CORROSION OF PAINTED METALS.**—The current issue of the *Journal of Industrial and Engineering Chemistry* contains the result of an important investigation by Messrs. Walker and Lewis of the causes of the corrosion of metal surfaces that have been painted or varnished. It has been found in practice that in tin cans which have been lacquered inside the corrosion under the influence of acid fruit juices has been much more rapid than in the case of untreated cans. This rapid corrosion takes place at points where the lacquer has been removed by soldering, etc., and is sometimes so pronounced as to cause puncturing of the can in a few weeks. The cause of this has been traced to the depolarising action of the lacquer itself, coupled with the action of the small proportion of air left in the can. The varnish coating being still unsaturated will absorb hydrogen. The protected surfaces will be thrown into the cathodic state, and the solvent action of the fruit juices will be concentrated at the exposed places. The corrosion will then continue until the air has been consumed and the lacquer has become saturated.

In the experiments upon which these conclusions were based two electrodes, one of ordinary iron and the other of lacquered iron, were inserted in the limbs of a V-tube containing potassium chloride solution, and provided with an air-free plug of agar-agar at the bottom. When the electrodes were connected externally a strong reaction for iron was invariably obtained in the limb containing the plain iron, and tests made with Ostwald's bromide voltameter showed that the corrosion was the result of an electric current proceeding through the external circuit from the lacquered iron. To find a complete remedy for the trouble in the case of fruit cans it will be necessary to discover a lacquer impervious to the solution, or, failing that, one that will not act as a hydrogen depolariser.

These results also have an important bearing upon the resistance of metals coated with paint to corrosive influences.

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The films of paint, etc., exposed to the air finally become completely saturated, but this does not destroy their porous character or prevent the possibility of corrosion at any exposed points due to the depolarising action of air through the film. This explains the pitting of iron or steel surfaces at places where the paint has peeled off, and also shows the necessity of having the surface of the metal clean before the application of the paint. So long as the film is intact no corrosion of the metal takes place, but the surface beneath the paint appears to become cathodic if an exposed area in its neighbourhood can act as an anode. Under the influence of the cathodic liberation of hydrogen the film is gradually detached from the metal, and corrosion of the exposed areas is greatly accelerated.

**VARIATIONS IN THE FAT OF ANIMALS.**—It was shown some years ago by Mr. Otto Hehner and the present writer that the fat taken from different parts of the same animal varied both in its physical characteristics and chemical composition. Thus, fat from the kidneys of a sheep was found to contain a large proportion of stearic acid, whereas that from the neck of the animal was nearly fluid, and quite free from stearic acid. The proportion of liquid fatty acids in the different fats was approximately measured by what is termed their "iodine values," *i.e.*, the percentage of iodine that they would absorb, and these figures showed equally great variations.

The results of a similar investigation on the same lines have recently been published by Messrs. Moulton and Trowbridge, who have examined the fat from different parts of oxen. They find that there is an intimate connection between the amounts of fat and of moisture and protein in the fatty tissue of animals, a high proportion of fat being associated with a low proportion of moisture and protein, and *vice versâ*. The proportion of fat in the fatty tissue increases with the fatness of the animal, and that of the moisture with the leanness, so that the condition and not the age is the determining factor. The percentage of fat in the fatty tissue increases from the outside to the inside of the animal, while the moisture shows a decrease. The iodine value (indicating the percentage of liquid unsaturated fatty acids) increases with the age and with the fatness of the animal, whereas the melting point of the fat decreases. A similar increase in the iodine value and decrease in the melting-point may be observed on proceeding from the outside to the inside of the animal, and there is a relationship between the two values, the one rising as the other falls. The specific gravity of the fat also varies with the iodine value.

## GEOLOGY.

By EDWARD A. MARTIN, F.G.S.

**EGYPTIAN GEOLOGY.**—In a paper read before the Geological Society, Dr. W. F. Hume, M.A., F.G.S., Superintendent of the Geological Survey of Egypt, divides the fossiliferous cretaceous strata into three series: A northern Antonian type, marked by Cenomanian species, including typical Turonian strata; a central Egyptian or Hammama type with a western chalky limestone indicating a close affinity with the white chalk of Northern Europe.

A southern or Dungul type, having close affinities with the former, and the fauna consisting of a group of specialised sea-urchins and of gastropods among which Turritellæ are very prominent. Dr. Hume emphasises the uniformity of the Lower Eocene throughout Egypt, its triple subdivision being recognisable over vast areas. In the Middle Eocene this uniformity is replaced by differentiation, the well-known regions of the Fayûm and the Moqattam Hill differing from the succession in the area selected as typical in his paper.

The Cretaceous and Eocene beds differ lithologically, limestones being dominant in the Lower Eocene and shales in the Upper Cretaceous. Palæontologically, great groups such as the Ammonites, still abundant in the Upper Cretaceous, disappear in the Eocene and are replaced by the characteristic nummulinid foraminifera. On the other hand, both periods bear a strong resemblance to each other in the dominance of oysters and sea-urchins over other forms. A notable feature is the comparative rarity of brachiopoda in Egypt throughout both periods, nor have belemnites been recorded from the Egyptian Cretaceous. Among post-Eocene formations the calcareous grits are shown to have a wide extension; but in the Desert they differ in character from the mammal-yielding beds of the Fayûm. The cretaceous period in Egypt was therefore one, in the main, marked by the gain of sea over land, the Eocene was one of rest, while at the close of the Eocene and during the Oligocene the approach of a continental phase is clearly indicated.

**CAMBRIAN TRILOBITES.**—Some small trilobites from the Cambrian rocks of Comley, Shropshire, during the progress of excavations, were described by Mr. E. S. Cobbold, F.G.S., in a paper read before the Geological Society of London on December 1. The specimens were derived from the *Olenellus* Limestone of Comley, and from the Grey Limestones which intervene between that horizon and the Conglomeratic Grit yielding a *Paradoxides*-fauna.

Mr. Cobbold refers to the occurrence of *Microdiscus lobatus*, Hall, *M. speciosus*, Ford, *M. helena*, Walcott, and *Ptychoparia* (?) *attleboroughensis*, S. and F. He describes eleven species, apparently new, which he refers to the genera *Microdiscus*, *Ptychoparia*, *Micmacca* (?), *Agraulos* (*Strenuella*), *Anomocare* (three species), *Protolenus* (two species), and two species to a new genus, to which Mr. Matthew's species *Micmacca* (?) *plana* may also be referred. In the discussion following the paper, Mr. Fearnsides, as secretary to the "Excavation of Critical Sections" Committee of the British Association, congratulated the author on the great success of his trench-digging operations, and remarked that the discovery of three distinct faunas within a thickness of 6 feet of coarse-textured sediment was of great interest. It drew attention to the sharp contrast between the Lower Cambrian rocks of Shropshire and of Merionethshire, and showed that the Comley rocks were much more like the contemporaneous rocks of the Baltic area.

**STONES IN A TREE-STUMP.**—A portion of a stump of a tree, in which some large whitey-grey flints had come to be imbedded during growth of the tree, was exhibited at the meeting of the Geological Society on December 16, by Mr. C. Carus-Wilson, F.G.S. The specimen was interesting, in that it shows how trees might be the means of conveying stones by water for great distances, and far from the place of origin of the stones. In this case the flints were firmly imbedded and would probably only be loosened by the rotting of the tree.

**GEOLOGISTS' ASSOCIATION.**—The first of four parts which are to constitute the jubilee volume of the Geologists' Association, "Geology in the Field," has been issued, and deals with the home counties more particularly. The work will commemorate the completion of the fiftieth year of the existence of the Association.

## METEOROLOGY.

By WILLIAM MARRIOTT, F.R.MET.SOC.

**ROYAL METEOROLOGICAL SOCIETY.**—At the meeting of this Society on December 15, Dr. W. N. Shaw, F.R.S., read a paper on "The Variations of Currents of Air Indicated by Simultaneous Records of the Direction and Velocity of the Wind." He said that in order to form a mental picture of the changes which are taking place in the amount of air flowing past an anemometer, we need to take into account the changes of direction as well as the changes in velocity. He had endeavoured to combine these in what he called a "Vector diagram," and he pointed out some interesting results which he had obtained from such diagrams.

Two practical and interesting papers were also communicated by Mr. W. G. Reed, junr. These formed part of the work done in the course in Climatological Research given in Harvard University, Mass., U.S.A., under the

direction of Prof. R. de C. Ward. The first paper was "A Critical Examination of South American Rainfall Types," the object being to make a simple yet accurate map, showing the seasonal distribution of rainfall in South America.

The second paper was "The Study of Phenomenal Climatology." The suggestion has several times been made that treatment of weather elements by days and months is arbitrary and unnatural for places not within the tropics. The author pointed out that in latitudes subject to cyclones the distribution of weather elements depends largely upon the relation of cyclones and anticyclones; and he therefore suggested that the cyclone is a more rational unit than the day or the month.

**THE GALE OF DECEMBER 2-3, 1909.**—During the afternoon of December 2 a deep cyclonic disturbance appeared off the north-west of Ireland, which subsequently travelled eastward and increased in intensity. The barometric gradient became unusually steep over Ireland, England, and the adjacent regions. The readings of the barometer at 7 a.m. on the 3rd were as low as 28.03 ins. at Spurn Head, and 28.09 ins. at North Shields. During the progress of this disturbance the wind increased rapidly from south-west and west, and on the night of the 2nd it blew a strong to whole gale over nearly the whole of Ireland, England, and France. In the "Weekly Weather Report," the wind velocities at several stations were stated to have been as follows:

| | Greatest "run" in one hour. | | Greatest velocity in a gust. | |
|---|---|---|---|---|
| Kew .. .. .. | 31 miles | from W.S.W. | 59 miles | per hour. |
| Shoeburyness .. | 38 ,, | ,, — | 72 ,, | ,, |
| Gorleston .. .. | 41 ,, | ,, W.S.W. | 65 ,, | ,, |
| Alnwick .. .. | 37 ,, | ,, N. | 66 ,, | ,, |
| Holyhead .. .. | 54 ,, | ,, N.W. | 69 ,, | ,, |
| Scilly .. .. .. | 49 ,, | ,, W. | 75 ,, | ,, |
| Pendennis Castle .. | 55 ,, | ,, — | 75 ,, | ,, |
| Fleetwood .. .. | 66 ,, | ,, W.N.W. | — | |

**HOURLY REGISTERING-BALLOON ASCENTS.**—The Meteorological Department of Manchester University liberatel 25 registering balloons from Manchester at intervals of one hour on June 2 and 3, 1909. Twenty of these balloons have been recovered, but one burst prematurely, and one trace was illegible. The tabulations of the 18 satisfactory records are given in a special supplement to the "Weekly Weather Report."

The distance travelled by the balloons and the temperature gradient in degrees centrigrade per 100 metres from 0 to 8 kilometres (5 miles) were as follows:

| | Hour. | Distance, Miles. | Gradient, ° | | Hour. | Distance, Miles. | Gradient, ° |
|---|---|---|---|---|---|---|---|
| June 2, | 7 p.m. | 59 | 0·62 | June 3, | 10 a.m. | 36 | 0·60 |
| ,, | 8 ,, | 75 | ·60 | ,, | 11 ,, | 47 | ·60 |
| ,, | 9 ,, | 59 | ·62 | ,, | Noon | 31 | ·62 |
| ,, | 11 ,, | 50 | ·60 | ,, | 2 p.m. | 31 | ·59 |
| ,, | 3, 1 a.m. | 59 | ·64 | ,, | 3 ,, | 31 | ·57 |
| ,, | 3 ,, | 50 | ·57 | ,, | 4 ,, | 31 | ·59 |
| ,, | 5 ,, | 50 | ·58 | ,, | 5 ,, | 19 | ·59 |
| ,, | 6 ,, | 40 | ·61 | ,, | 6 ,, | 25 | ·66 |
| ,, | 9 ,, | 36 | ·60 | ,, | 7 ,, | 16 | ·70 |

**THUNDERSTORM DURING A BALLOON ASCENT.**—Mr. Charles P. Glidden has communicated to the U.S. "Monthly Weather Review" the following account of a thunderstorm experienced during a balloon ascent:

"Aeronauts in the balloon that ascended from Pittsfield on the afternoon of May 24, 1909, had an unusual experience. At an elevation of one mile and 30 minutes after the start, three showers and thunderstorms were noticed, one in Hoosic Valley, another in the Connecticut, and the third near Worcester. The balloon rose and fell through intervals varying from 1,000 to 10,000 feet, and several times was caught in varying currents which caused the basket to turn and swing from side to side. Under one mile elevation the balloon travelled in advance of one of the storms at a speed of about 40 miles an hour, while at an elevation of 10,000 feet calm and sunshine prevailed with the storm passing rapidly below them. Lightning flashes were frequent and heavy peals of thunder shook the basket. After the storms had passed under the balloon, a rift in the clouds enabled the aeronauts to drop down into a clearing free from clouds and to make a landing without difficulty. This established the fact that above the storm there existed bright sunshine and no wind."

**TRANSVAAL WEATHER REPORTS.**—The establishment of the Transvaal Meteorological Observatory at Johannesburg was mainly the result of a petition which was presented to the Government in 1902 by the local branch of the South African Association for the Advancement of Science. The Observatory was got into working order in 1903, and steps were also taken for the collection of meteorological observations in the colony. The number of stations reporting to the Observatory during the year ending June, 1908, was 547.

The following work is done by the Observatory:

A morning report is telegraphed to the Meteorological Service of the Cape Colony, Orange River Colony, and Natal, and to the Port Captain at Lourenco Marques.

A weather report, based on the morning telegrams received from stations in the Transvaal or telegrams received from outside the Transvaal, is drawn up daily and transmitted to various Government Departments and the daily Press at Pretoria and Johannesburg.

A general forecast on the weather probabilities is prepared daily at 2 p.m. On this is based a brief forecast of the weather to be expected during the ensuing twenty-four hours, which is telegraphed to every postal telegraph office in the Transvaal for publication on a notice board, and also to the Port Captain at Lourenco Marques. The general forecast is published in the *Star* (Johannesburg) in the afternoon; and it is also sent to other newspapers, the Agricultural Department, and to several farmers. No charge is made for these forecasts, but applicants have to supply addressed envelopes. The synoptic maps on which the forecasts are based are not published because of the expense. Special forecasts, such as flood, hail, or frost warnings, are occasionally issued.

Weekly summaries of the weather are sent to several public bodies by special request.

A monthly return of temperature, rainfall, and the weather characteristics appears in the "Government Gazette" each month. Reprints of this return are subsequently distributed.

## ORNITHOLOGY.

By W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U., &c.

**PLUMAGE SEQUENCES IN BRITISH BIRDS.**—It seems to be very commonly supposed that all that is worth knowing on the subject of British birds, and especially in plumages, has long been gathered together in the pages of the innumerable books on British birds that have made their appearance during the last few years. But this is so far from being the case that in hardly a single species is the full sequence of plumages known from the nestling to the adult. In no book that has yet appeared have nestling plumages received any recognition, save a casual remark here and there.

In *British Birds* for December the editor, Mr. H. F. Witherby, announces his intention to fill this gap in our knowledge by publishing during the coming year, in the pages of his magazine, a series of papers on this theme. Of necessity these cannot be complete, as yet, nor can any consecutive series of species be dealt with, for the facts have yet to be harvested.

In the December issue just referred to, Mr. Witherby commences the series with a general outline of the ground to be covered, and of the work already achieved by Mr. Johnathan Dwight, an American naturalist, on the birds of the United States.

**YELLOW-BROWED WARBLER IN LINCOLNSHIRE.**—Mr. C. H. Caton Haigh, in *British Birds* for December, records the fact that on October 12 he shot a male Yellow-browed Warbler (*Phylloscopus superciliosus*) at North Cotes. A fresh south wind was blowing, and there had been a gale from the same quarter on the previous day.

XUM

**RED-BREASTED FLY-CATCHER IN LINCOLNSHIRE.**—On September 16 Mr. Caton Haigh writes to *British Birds:* "I shot an immature male of the Red-Breasted Fly-Catcher from a hedge near the coast at North Cotes"—the first recorded occurrence, apparently, of this bird in Lincolnshire.

**WHITE-TAILED EAGLE IN THE SCILLY ISLANDS.**—We regret to learn that one of these fine birds was shot on one of the Scilly Islands on November 11. Another bird was seen in the neighbourhood, and we surmise that this will soon succumb to the boor with a gun.

**THE INCURSION OF CROSSBILLS.**—Parties of the invading host of Crossbills which have visited these shores during the latter half of this year still remain with us. Mr. J. G. Millais sends to the *Field* (December 4) an interesting account of flocks which still haunt the Scotch and Douglas fir tracts in the St. Leonardslee forest, all birds of the continental form; and Commander Lynes, in *British Birds* for December, gives some extremely valuable maps plotting out the main features of the irruption.

**FEMALE BLACK GROUSE ASSUMING MALE PLUMAGE.**—Few records have been made of this curious and interesting abnormal condition in the Black Grouse. Mr. J. G. Millais, in the *Field* (December 4), describes in some detail a case of this kind from a bird killed on the Duke of Buccleuch's Estate in Dumfriesshire, on November 15. Herein the plumage was intermediate in type between that of the grey-hen and black-cock. The ovary was atrophied. A few days after this bird was killed the body of another similar specimen was picked up on the same moor. Herein, however, the plumage of the body was that of a normal grey-hen, but the tail was the tail of a black-cock—at any rate as to shape; the coloration took the form of black bars on a rich brown ground.

## PHYSICS.

By PROFESSOR A. W. PORTER, B.Sc.

**CRYSTAL RECTIFIERS.**—Attention has already been called in these columns to the apparent unilateral conductivity of certain crystals in contact with solid metallic electrodes. Professor G. W. Pierce returns to the problem in the *Physical Review* for November. It seems that as long ago as 1874 Ferdinand Braun observed similar phenomena with a series of natural metallic sulphides—copper and iron pyrites, galena, and copper-antimony sulphide—the current being greater in one direction than in the other; moreover, he observed that the difference increased with increase of the current and that on keeping the circuit closed, the current from that direction in which the resistance was smaller increased, while from the opposite direction it decreased.

In the present experiments Professor Pierce obtains much more complete rectification, using some specimens of iron pyrites presented by the firm of Clapp and Eastham, of Boston. With a careful adjustment of the copper contact at particularly favourable spots of the pyrites the device is a very sensitive detector for electric waves. Rather curiously for some adjustments of the contact the greater current is from the copper to the crystal, and for other adjustments (*e.g.*, with a different pressure or at a different point of the crystal) the greater current is from the crystal to the copper. From his experiments he concludes that the action does not take place though the intermediation of thermo-electricity; though the fact that all crystal rectifiers have also large thermo-electromotive forces against the common metals may be due to the fact that rectification and thermo-electricity have a common basis.

In the same Journal Alan E. Flowers also deals with the same question. Amongst other results he finds with galena that at a certain voltage depending upon the setting a break-down may occur. This break-down point may, for example, be for 15 or more volts with 30 to 40 milliamperes flowing from point to crystal on fresh rectifying spots and may be as low as 5 volts and 90 milliamperes after several break-downs. The fact that the reactions occur near the surface or in the surface film is shown by the fact that almost the whole of the drop in potential occurs near the point of contact. The rectification does not seem to be an effect of the sharpness of the metal contact. There is apparently no difficulty in rectifying currents of very high frequency (1,000 alternations per second). The rectification disappears at a high temperature (about 270° C.), but is partially regained on cooling. A rectifying film can be produced artificially by electro-chemical treatment with amorphous sulphur.

**NEUTRAL DOUBLETS IN VACUUM TUBES.**—"Everything points, I think, to the conclusion that even at the start from the cathode the Canalstrahlen include a large number of neutral doublets, if, indeed, they do not wholly consist of them. These neutral doublets are found not only in Canalstrahlen (the rays at the back of the cathode which have passed through it); they are also found in front of the cathode travelling away from it, mixed up with rays which carry a positive charge of electricity, and which are thus travelling against the electric field. These neutral doublets are very interesting, as they form an intermediate stage between the ion and the neutral molecule."—(Sir J. J. Thomson, *Philosophical Magazine*, December.)

**RELATION BETWEEN URANIUM AND RADIUM.**—Mr. F. Soddy describes in the *Philosophical Magazine* (December) further facts in relation to the three uranium solutions purified by Mr. T. D. Mackenzie between three and four years ago. In each the growth of radium is proceeding according to the square of the time within the error of measurement. The "period" of the direct parent of radium is calculated from these results to be 18,500 years in the case of the oldest of the solutions; but in the case of the solution prepared last, the amount of radium present is less than the corresponding value. This suggests the existence of at least one new product, "Uranium A," intermediate between uranium X and the parent of radium, with a period of the order of one year.

## ZOOLOGY.

By R. LYDEKKER.

**ENGLISH ANIMAL NAMES.**—Objection has been taken by a reviewer of a certain book to the use of the term "mallard drake," as being a tautology, and the same critic would possibly likewise object to the designation "mallard duck" for the female of the same species. Now I am not going for one moment to maintain that, strictly speaking and etymologically, he is not perfectly right and justified in his objection. But there is no doubt that it is extremely convenient to have a single English name for every well-known species of animal, and in this respect mallard is in every way preferable to and more convenient than wild duck, as it is manifestly incorrect to speak of a wild duck "drake," or a "wild duck duck." Indeed, if we cannot use the term mallard in a specific rather than in a merely sexual sense, we are debarred from employing the term drake, which has become the accepted designation for the male of every member of the duck-tribe, in connection with the species at all.

As a matter of fact, it is in many cases extremely difficult to decide what is the proper English name for certain species of animals; and it seems indeed very doubtful whether our ancestors ever had species-names at all for many of the better known and larger mammals and birds, contenting themselves apparently with a name for each sex of such species. The human species itself affords a case in point. It is true, indeed, that, in the first chapter of the book of Genesis, the term "man" is used to denote both sexes, although the expression "in the image of God created he *him;* male and female created he *them*," seems to indicate some hesitation on the part of the translator as to whether this usage was justifiable. But even if it be, we cannot speak of a "female man," and are driven to use some such periphrases as the "human species" when we wish to refer to *Homo sapiens* in a specific sense.

The want of a collective term is still more pronounced

in the case of *Bos taurus*, as bull is restricted to the male, and cow to the female, while, in addition, there are such terms as steer, heifer, and calf for the immature stages of the species.

Ox (= the animal that draws) is, indeed, sometimes used as the species name, while its plural, oxen, is constantly employed as the designation of the whole group, but it properly denotes only the castrated male. Cattle (= chattel, a possession), a word which was originally used both in the singular and the plural, is also often employed in the latter sense; although properly it includes not only "horned cattle," but likewise sheep, goats, horses, and even pigs. It seems therefore quite clear that there is no English equivalent to *Bos taurus;* and as we cannot possibly speak of a "female bull," the use of the term "ox" in this sense is a convenient, although not correct, compromise.

I have also some doubt whether we have an English equivalent for *Equus caballus*, of which the sexual names are stallion and mare. It might be thought that horse is the species-name, but since it is equivalent to the German *ross* and means the neighing animal, it seems highly probable that it is really the equivalent of stallion. The existence of such special names as colt, filly, and foal for the immature stages is in favour of this view. "Horse" has however, become the adopted species-name.

*Cerous elaphus* affords an excellent instance of an animal which originally had no species-name, but was designated according to sex and age by such terms as stag, hart, brokket, hind, and calf or fawn. Its current name of red deer is no doubt comparatively modern; deer being the equivalent of the German *tier*, and originally denoting wild game in general, so that the expression "mice and such small deer" is etymologically justifiable.

Sheep (= the animal to be guarded) does, on the other hand, appear to be the name of a species, of which the sexes and young are denoted as ram (the butting animal), ewe, and lamb.

Swine (although not pig, which means a young individual of either sex of the species) would likewise seem to fall under the latter category; boar and sow being the sex-names.

Dog (=the biting animal, from *dakna*) and bitch, fox and fix (plural fixen = vixen), lion and lioness, gander and goose, drake and duck, and black-cock and grey-hen, are, on the contrary, examples of sex-names for which there appear to have been originally no equivalent species-names. In some of these, as in many other cases, the male title has, however, become the species-name, while in the case of two the female designation has been made the dominating title. So much is this the case that it is perfectly legitimate to speak of a female dog or female fox, even if it may be wrong to talk of a male duck. This being so, it seems to me that in cases where its original meaning is not self-apparent, as in the instance of mallard, there is no great objection to raising a sex-name to the rank of a species-name.

The most unsatisfactory cases are afforded by sex-names like black-cock and grey-hen, where there is no corresponding species-name, as these are obviously applicable only to the particular sex to which they refer. In this instance it has been proposed to substitute the title black grouse, but this is objectionable on two grounds; firstly, that it is a book-name, not "understanded of the people," and secondly, that the bird in question is more nearly related to the capercaillie than to the true grouse. The term black-game is even worse, as it cannot be used in combination with a sexual prefix.

**A NEW INSECTIVORE.**—It is an old and trite remark that the scattered distribution of the members of the insectivora and the remote corners of the earth in which many of them are found afford conclusive evidence of the antiquity of this primitive and waning group of mammals. Additional evidence of this is afforded by the discovery in Sze-chuen of another member of the group, which has been named *Neotetracus sinensis;* the name being intended to suggest affinity with the small and imperfectly known *Tetracus nanus* of the French Miocene. The smallest member of its group, *Neotetracus* is nearly related to the Malay *Gymnura* and *Hylomys*, and the Philippine *Podogymnura;* but while approximating to the last in external characters, and especially the well-developed tail, it agrees with the hedgehogs in the character and number of the teeth and likewise in the presence of vacuities in the palate, so that it forms a kind of connecting link between the *Gymnurinæ* and *Erinaceinæ*. In size the Sze-chuen species may be compared roughly to a half-grown rat; but the general colour of its coat is reddish yellow.

**PAPERS READ.**—At the meeting of the Zoological Society of London held on November 9, Sir H. H. Howorth read a paper on certain shells and the light they throw on late physical changes in the earth's surface, directing particular attention to the case of the gaper (*Mya arenaria*). Mr. C. T. Regan discussed certain Asiatic fishes related to the famous climbing-perch; and Mr. L. Bonhote discoursed on certain Egyptian beasts. At the meeting on the 23rd, Mr. G. S. Shortridge made observations on the distribution of Australian quadrupeds; Mrs. Sexton described certain crustaceans from the Bay of Biscay; and Col. Fawcett discussed certain abnormally formed organisms from the Andamans.

## CORRESPONDENCE.

### Astronomical Superstitions.

To the Editors of "KNOWLEDGE & SCIENTIFIC NEWS."

SIRS,—Your editorial announcement is interesting and welcome, but your readers here hope the "improvement" promised is not to be gauged by the character of the article "Astronomical Superstitions," imported from America, and appearing in the December number. I have taken "KNOWLEDGE" since my college days, and introduced it into the local high schools, male and female, and look out eagerly for it every month, but my subscription for it, and theirs, would end at once, if it admitted such an openly atheistic and irreligious tone into its professedly scientific articles.

I do not refer to such portions of the articles as describe, correctly enough, popular and purely lay superstitions of every age, but when the editor of a *purely scientific journal* so far forgets his office, in a Christian country, as to pass such expressions as abound in the second column, page 449, classing Christianity with Mahomedanism, and implying that exploded scientific theories of creation are, or were at any time, defined "*dogmas*" of the Christian church, to be believed under pain of heresy (for that is the sole and exclusive meaning of "dogma" in religion), we have reason to complain. Surely a footnote explaining that such theories were never defined as dogmas, or embodied in the formulas of faith proposed for obligatory faith on Christians, would not be beyond the function of an editor, *if he admits the paragraphs at all*. It is a threadbare fact of history that Galileo was never accused of heresy, but only bidden keep provisional and precautionary silence about a theory so new and startling that it *seemed* to be dangerous to faith. Governments every day follow the same policy in political matters.

But the closing paragraphs are the most offensive. What business has a scientific journal with a stale diatribe against the supernatural and the miraculous? What must be the feelings of the hundreds of your readers who do not find it impossible to unite solid scientific learning and research with a sincere supernatural religion when they find a writer admitted to your pages who goes to Mark Twain for a definition of their most sacred convictions, and calls them all "illogical and immoral"?

We can get that sort of thing in tons from the Rationalist Press for 6d., or in Hyde Park for nothing, but I am surprised at the appearance of it in "KNOWLEDGE," a journal of science.

Awaiting with interest the promised improvement,

I am, yours, etc.,

(REV.) JOSEPH W. BRADY, S.T.L.

Parochial House,
Armagh, Ireland,
*December* 9, 1909.

XUM

SIRS,—I have been reading the entertaining article which you reprint from the *Popular Science Monthly* (New York), and thoroughly enjoyed it till I came to the last two paragraphs, where the writer speaks at large on the philosophy of natural science. I have no means of judging to what extent he reflects the prevailing views on the other side of the Atlantic, but some of his sentences cannot be allowed to pass here without challenge.

Take, for example, "In the operation of cosmic forces it may now be said that events occur by mechanical necessity, regardless of man's interest." If he had written "events *are assumed* to occur by mechanical necessity" he would have been in harmony with the leaders of thought here. And surely, too, the day has long gone by when it was said, "that mystery has now been driven from the universe."

It is, of course, true that all the methods and the language of science take the form which assumes that mechanics will explain all, but it is nothing short of an ignorant misrepresentation, to which I have no doubt you do not wish to give your imprimatur, to convey an impression that that is the complete attitude of science to the universe around us. A mechanical view of the universe is, as Prof. Lamb puts it, "a convenient fiction"; Lord Kelvin has pointed out the futility of supposing that because mechanics explains much, it explains all.

When the author asserts that reason is our only guide to truth and that "emotion has nothing to do with the attainment of truth," why does he not go to the logical conclusion and bar all moral forces, and say that our will-power does not even help? This would indeed be what Prof. Tait has called "the pernicious nonsense of the materialist."

Yours, etc.,
J. A. HARDCASTLE.

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SIRS,—I received the December number of your journal to-day, and noted with satisfaction your intention to make improvements for the coming year. In this connection there is a certain feature of the past few months against which I now make earnest and vigorous protest, namely, the scurrilous attacks upon the Roman Catholic Church which you occasionally print. Of course, if you wish to make your journal a repository for the ill-digested venom of people whose ignorance is their chief claim to public notice, it is ultimately your own affair. Such an article as that copied from *Popular Science Monthly*—Popular Ignorance would more nearly hit the mark—should not have been allowed to disgrace your columns. Some months ago I addressed you on a similar topic, and I should think that the example of such scientific English Roman Catholics as Fathers Cortie and Sidgreaves, of Stonyhurst, Miss Agnes M. Clerke, and others would be sufficient to deter any reputable journal from incurring the odium of lending its columns to such purposes.

Yours, etc.,
CHARLES C. CONROY, A.M., M.S.

540 E. 15th Street,
Los Angeles, California,
*December* 16, 1909.

[We insert these letters because we respect opinions honestly expressed; but while we do not necessarily identify ourselves with the views of the writer of "Astronomical Superstitions" we think that the assault on them by our correspondents is lacking, in one case at any rate, in tolerance.]

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## Ornithology.

SIRS,—I shall be grateful if you will insert a few words from me in answer to Mr. Pycraft, on the subject of the ryper.

As I answered a letter in the *Field* on this subject some weeks ago I meant to have let the matter drop, but as everyone to whom I have shown my letter to "KNOWLEDGE," and Mr. Pycraft's reply, consider that "abuse" is much more conspicuous in his letter than in mine, I feel bound to say something to defend myself.

I may say, now, that I apologise for anything which Mr. Pycraft may consider "abuse" in this present letter, and I certainly never meant to put any in my last.

As, according to Mr. Pycraft, I am not qualified to form an opinion on the benefit or otherwise of introducing ryper to Scotland, I quote the following from a letter from my friend, Mr. Noble, himself one of our best naturalists.

He says: "I think Montagu, in his letter to the *Field*, is wrong about the willow grouse. There can be no doubt this bird and our grouse are one and the same. When Scotland was joined to the mainland these birds had an unrestricted range throughout Northern Europe. When our islands were cut off the habits of *Lagopus scoticus* changed, though, no doubt, it took many years, until now we have an 'Island form,' which can hardly be called a 'species' even. Now, if this is so, and it *is* a fact, how can the introduction of *L. albus* do harm to our bird? How can they possibly swamp the red grouse? The same environments which changed the habits of *L. albus* are still present, and this bird in course of time will become *L. scoticus*, as their relations did thousands of years ago. You have simply gained a change of blood."

Whether the ryper will stick to the scrub remains to be seen. Now, I am on my own ground. I have shot a good many ryper in Norway and many thousands of grouse in Britain, and I can assure Mr. Pycraft that Scotland is *not* already well supplied with game, in many places not supplied at all, on the class of ground I should like to see ryper. That black-game can ever become numerous again, no sportsman who recognises the fact of the immense amount of drainage which goes on now believes, apart from any other causes for their decrease.

A young ryper is every bit as good eating as our grouse, when it is feeding on much the same food as the latter. It is not fair to take the ryper which is sent over in winter as an example, and these are the only specimens most Englishmen have eaten.

In speed of flight and "wildness" in bad weather the ryper and grouse are identical.

I am afraid I do not know what "eugenics" mean, so I cannot argue on that. I can only hope that my ryper will never become as "mischievous" as Mr. Pycraft seems to think I am.

Yours truly,
W. STEUART-MENZIES.

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SIRS,—Natural selection and the survival of the fittest limit forms, and combined with the tendency in living things of like to produce like to a great extent determine them. For some, or rather for no, reason, many Darwinians who have concentrated their attention on the above-mentioned limits resent any attempt to draw attention to any others, almost as though it were an act of disloyalty to our great chief. On the other hand, if any other causes or limits are found the theologians, whose wish is father to the thought, or perhaps all the thought they possess, raise the cry of the bankruptcy of science and drum it like howling monkeys, or the silversmiths of Ephesus, all over the place. And yet the more cause and limits are found, the more possible appears evolution and the relative fixation of species, within a reasonable lapse of time, and not the less so. The laws of space form a limit to the forms of things, which seem to be too much ignored, but might contribute to a real science of morphology, which is at present chiefly dependent upon guesswork and statistics. To take a simple instance, buckwheat and beechmast are both pryamidal seeds on a triangular base. Therefore the three angles at the apices must always sum less than 360°.

To take a more complex case. All living things multiply by cell-division, giving the series 2, 4, 8, 16, etc., or more simply 2n, and the cells are on an average of the same size and normally globes or discs.

Suppose a life-form, springing from a single cell and discoid. The cells may be arranged, in a loose circle. There is a good instance in Nature, viz., the teeth of the calyptra of mosses, always 0 or 2n in number It would be interesting to know whether they can be actually traced to a single cell's sub-divisions. For the first few terms of the series, in the case of coherent discs, the possible arrangements are very few; 2, no possible arrangements; 4,

one; 8, one, viz., 3 cells surrounded by 5, which gives the 3 initial numbers of the phyllotaxis series 3, 5, and 8, and the commonest arrangement of angiosperm flowers, viz., 5 petals round a trifid capsule. 16 gives also practically only one coherent discoid arrangement, viz., 5 surrounded by 11. In intyba chicorea, 16 florets can be proved statistically to be the normal one, and I have proved geometrically that the seeds, and, therefore, the florets are arranged as above. Passing on to 32, there is the possibility of coherent discoid forms consisting of more than 2 concentric rings of cells and the possible arrangements become more complicated.

Yours, etc.,
W. W. STRICKLAND.

Milan,
*November* 6, 1909.

### Transformation of Eels.

SIRS,—I have read with interest Mr. Cunningham's paper on this subject in your November number. May I be permitted to give you a brief account of my acquaintance with one of the Leptocephali commonly known in India under the name of the "Bombay Duck?" In the standard work on the "Fishes of India," by Day, written before the Italian discovery of 1891-92, this was classed by him in a separate order, without any knowledge of its subsequent history. In its natural condition the "Bombay duck" is a transparent fish-shaped larva, with a long gaping beak, armed with gristly teeth, something like the mouth of an infant crocodile. It frequents the estuaries and mouths of large rivers, where the water is more or less brackish. On one occasion I was a passenger on a Government steamer anchored in the estuary of the Hooghy. The captain proposed to catch some "Bombay ducks" for a curry, which he told us we should find an excellent dish. A small net was held at the foot of the ship's ladder in the strong flowing stream, and in a few minutes was brought up with half a dozen of these transparencies, which had floated into it, and a succession of dips of the net secured a score or two of our Bombay ducks for the curry. Although placed at once in a pail of sea water they quickly died, the least splashing of the water seeming to be fatal to their delicate frames. One of them, about eight inches long, I held up to the light, and within it saw a second, which had been swallowed whole, almost as long as its swallower. Inside this Jonah was a whole shrimp, the transparency being so perfect that even the colour of the shrimp was easily discernible. The curry was excellent, though almost too rich and oily.

For the market these larvæ are dried in the sun, and it is in the dried condition that they are known as "Bombay ducks," which are universally in India eaten with, and not as, curry. They have a pleasant aromatic flavour, are very brittle; a small piece being broken off and eaten as a condiment, just as a pickle is eaten with meat.

I have not been able to ascertain what form of eel is evolved from the "Bombay duck," but probably this will be known to your correspondent, Mr. Cunningham, and if so, I shall be glad if he could kindly give the information.

Yours, etc.,
EDWARD J. BUCK.

Naples,
*December* 12, 1909.

## REVIEWS OF BOOKS.

### ARCHÆOLOGY.

**Surveying for Archæologists,** by Sir Norman Lockyer, K.C.B. (Macmillan and Co.; 120 pp., including index; 4s. net).—The author has been led to write the hints contained in this work by requests which have reached him from time to time by those engaged in making observations on stone circles, avenues, etc. They wish to determine, independent of the shape, size, colour, etc., the lines of direction indicated by the lie of the stones in various monuments, and the author shows them how to set to work. The importance of a correct knowledge of the variation of the needle is, of course, insisted upon, and an instance is cited to show how useless is the orientation of an explored temple, when the variation is unknown. The use of Ordnance maps is shown to be of greater service than many are aware of, and we learn that on future issues of the one-inch the variation for the district will be shown.

### ASTRONOMY.

**The Scientific Papers of Sir William Huggins, K.C.B., O.M., &c.,** being Vol. II. of the Publications of Sir William Huggins's Observatory (Quarto; xiv., 539 pp. with 66 illustrations; price £1 11s. 6d. net).—It is just ten years since the first volume of these "Publications" appeared—the magnificent "Atlas of Representative Stellar Spectra," by Sir William and Lady Huggins—and the present sumptuous volume is a fit companion and complement to the "Atlas." The present year is an extremely appropriate one for the publication of this volume, since it is just fifty years since Kirchhoff first showed the true significance of the Fraunhofer lines and, by his joint work with Bunsen, laid the foundations of Spectrum Analysis, that powerful instrument of research into the wonders of both the "infinitely great" and the "infinitely small." The history, in this direction, of these fifty years, given in the present volume, is the history of the new science of astrophysics, of which, indeed, Sir William Huggins may be said to be the founder. The astronomical observatory has ceased to be a place merely for routine measurement of angles and times of transit, and has become also a laboratory and general workshop. By the introduction into the observatory of the spectroscope and the photographic dry-plate a great harvest of new knowledge has been reaped, and astrophysics is to-day zealously cultivated in all the principal observatories of the world. It is interesting to learn that Sir William's interest in spectroscopic research was first excited by an exhibition of spectroscopes at a "soirêe" of the Pharmaceutical Society. It is difficult at the present day fully to realise the difficulties met with by the pioneers in the attempt to apply the new method of research to bodies so comparatively feeble in light as the stars. Even so bright a star as Vega only sends us about one forty thousand millionth part of that received from the sun. It is scarcely possible *now* to realise the large amount of time and labour expended in the successful construction of the first star-spectroscope. But the difficulties were overcome, and in 1862 a note "On the Lines of some of the Fixed Stars" was sent to the Royal Society, in which diagrams of the spectra of Sirius, Betelgeux, and Aldebaran were given. The first fully successful photographs of stellar spectra were obtained in 1876, after the introduction of the gelatine dry-plate; that of Vega showed seven dark lines of the hydrogen series (see "KNOWLEDGE," September, 1891, and March, 1909). In a later paper (*Phil. Trans.*, 1880, pt. II., p. 669) Sir William calls attention to "the remarkable arrangement in position in the spectrum of these lines," and suggests "whether these lines are not intimately connected with each other, presenting the spectrum of one substance?" It was not, however, till much later that the complete series of lines was observed in the spectrum of hydrogen in the laboratory. Space fails us to recount all the achievements of the pioneer recounted in this most fascinating volume. We can only remind the reader that Sir William Huggins was the first to observe (in 1864) the spectrum of a nebula, and to draw the important conclusion that certain nebulæ must be masses of incandescent gas; that he first (in 1868) showed that certain comets emitted the light characteristic of carbon vapour; and later (1881), by photographing the spectrum of a comet, detected the bands of cyanogen, showing the presence of both carbon and nitrogen (see "KNOWLEDGE," September, 1908). Sir William Huggins was the first to apply Doppler's principle to the measurement of motion in the line of sight. His results (published in 1868) were received with some incredulity (or neglect, at least) by astronomers generally, but time has proved that he was quite correct in his conclusions. The same method of observation has become fruitful in other directions, *e.g.*, it gives us the power of separating double stars which are beyond the resolving power of any telescope that can ever be constructed. The variability of Algol is supposed to be caused by a temporary eclipse of its light every 2½ days by the passage in front of it of a dark component; the revolution

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of the bright component round the dark one can be directly observed by the periodical shifting to and fro of the lines in the spectrum. A word as to the arrangement of the book. The papers have been arranged, in the first place, according to subjects, and, secondly, according to date of publication. This plan necessitates, in a few cases, the dividing up of a paper, part of which goes under one subject and part under another, but the student will appreciate the convenience of having all the observations made on one subject brought together. The separate headings are :—

Section I. Observatory and Instruments.
,, II. Spectra of the Fixed Stars.
,, III. Spectra of the Nebulæ.
,, IV. Motion in the Line of Sight.
,, V. Temporary Stars.
,, VI. Spectra of Comets.
,, VII. Sun and Corona.
,, VIII. Moon, Planets, and Aurora.
,, IX. Chemical Spectra.
,, X. Miscellaneous.
,, XI. Some Lectures and Addresses.

The illustrations consist of reproductions of all the original diagrams and spectra, the maps of the spectra of the chemical elements, four plates of drawings of Jupiter, views of the observatory from the outside and the interior, showing the telescope-spectroscopes, etc., and excellent portraits of Sir William and Lady Huggins.

## BIOLOGY.

**Mendel's Principles of Heredity,** by W. Bateson, M.A., F.R.S., V.M.H. (Cambridge: The University Press, 1909; 12s. net).—By now even those who have only a very slight knowledge of the more abstruse biological problems of the day are familiar with the phrase "Mendelism," and the general outlines of the principles thereof. Professor Bateson is the most gifted and brilliant exponent of Mendelism in this country, and in this book he has furnished all who are interested in the subject with an indispensable guide. Though no one would accuse Professor Bateson with a lack of judgment, it is obvious to those who have made themselves familiar with the aims of Mendelism that, in his enthusiasm for an undoubtedly great discovery, he is inclined to magnify its importance. He seems to desire to persuade us that he has at last discovered the master-key to the chamber which contains the secrets of life. However, after making due allowance for the zeal of the propagandist, it must be admitted that Mendelism throws a quite unexpected light on many hitherto obscure problems in matters of heredity—a light which will be of the highest service to the breeder both of plants and animals, and which, at no distant date, will probably be capable of yet further and wider usefulness. So far the study of Mendelism has not progressed beyond experiments in regard to single characters, made chiefly upon domesticated animals and plants, experiments which have yielded some very remarkable results, and not a few surprises. De Vries, one of the ablest and earliest exponents of the new learning, believed that "dominance" (prepotency) was an attribute of phylogenetically older characters, but this is not borne out by experiment. The comb-characters of fowls and the coloration of the nestling down are cases in point illustrating this aspect of the study. Thus, striped down is unquestionably a primitive character, yet in the cross brown-red game bantam and black-red, the stripes of the primitive plumage are replaced by a uni-coloured down. The "brown-red" bird, which, both in adult and immature characters, differs markedly from the ancestral stock, is yet pre-potent over the "black-red," which in both adults and immature stages recalls this stock. It remains for further experimenters to determine the significance of facts such as these. Hitherto such experiments have perforce been made without any possibility of analysis. Mendelism removes this obstacle, and thereby, as Professor Bateson points out, a new and apparently illimitable field of research is opened out. In the space at our disposal it is impossible to survey with fairness the contents of this most fascinating volume. It must suffice to say that it represents the most complete survey of the subject which has yet appeared, while illustrations, in the shape of coloured plates, photographs, and diagrams, have been distributed throughout these pages with a liberal hand, and they will go far to add to the usefulness of the book.

## BOTANY.

**Fungi and How to Know Them;** an Introduction to Field Mycology, by E. W. Swanton (Methuen and Co.; 6s. net).—If the author had confined his energies to the production of "An Introduction to Field Mycology" instead of attempting to cover the whole field, the result would probably have been more satisfactory. The introductory portion is mainly an echo of older works, although some parts are obviously original, and often not correct, as the statement that a rhizomorph is a very thick, hard, cord-like form of mycelium, or that there are probably not more than 250 species of fungi of any economic importance. In a book intended for beginners, it is most important that the student should, first of all, clearly grasp the broad principles that determine the scheme of classification adopted, and, before being introduced to details—species—should be in a position to refer any given specimen to its proper group. Instead of this preliminary necessity being carried out, we find the five primary groups, including practically all our larger fungi, dealt with on a single page, in a very brief, technical manner. Coming to genera, matters are still worse, as these are dealt with by "keys" alone, averaging about one line for each genus. Coming to species, we find the definitions brief, technical, and often inaccurate. In describing *Mucronella calva*, the author has obviously had something else in view, and the same is true of *Hypoxylon concentricum*, which is described as being the shape and size of a pea. Here some species of *Hypoxylon* proper has been mistaken for *H. concentricum*, which is not in reality a *Hypoxylon*, but a *Daldinia*. There are 16 coloured plates, and 32 black and white plates. Some of the figures are good and characteristic, some are poor, and some are meaningless.

## CHEMISTRY.

**The Periodic Law** (International Scientific Series), by A. E. Garrett, B.Sc., F.R.A.S. (London: Kegan Paul; pp. x. and 249; 5s.).—The periodic law has played so great a part in the modern development of chemistry, and has been made the basis of so many more or less speculative theories that it was a good idea on the part of the publishers of this well-known series to include a volume dealing specially with the subject. It must have been no light task to put before the reader a bird's-eye view, as it were, of the whole field, but the work has been very ably done by the author, who has succeeded in giving us a most interesting and suggestive book. The gradual development of the notion of a periodic arrangement of the elements up to Mendeléeef's periodic law is traced in a series of historical chapters, in which each of the succeeding theories is outlined and criticised. The other arrangements of the groups that have been suggested since Mendeléeef's classification are discussed in the same lucid manner, and chapters are also devoted to the further development of the law, and its relation with regard to the modern ideas upon the atom. Long before the enunciation of the periodic law by Mendeléeef, in 1869, attention had frequently been drawn to the remarkable similarities between the compounds of certain elements, and to the curious relationships that existed between certain atomic weights. After the more accurate determinations of the atomic weights between 1850 and 1860 came the first attempts to arrange the elements in a periodic sequence, first by de Chancourtois in France, and then, a little later, but quite independently, by Newlands, in this country. It is difficult now to understand the scant attention and laughter with which Newlands was received by the Chemical Society when he brought forward his "law of octaves," the ridicule culminating in a suggestion that he should try the effect of grouping the elements in accordance with the initial letters of their names. It is within the present writer's knowledge that Newlands made no secret of the fact that the reception given to his theory discouraged him from further work upon the subject, and it is probably owing to this that the honour of the discovery of the periodic law, as we now know it, rests with Russia instead of with England. No more striking vindication of the truth underlying the law could have been desired than the prophecy by Mendeléeef

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that if certain hypothetical elements required to fill the blank places in his table should be discovered they would have certain properties, and its fulfilment by the discovery of scandium, gallium, and germanium, with properties and compounds closely corresponding with those of the predicted elements. But the value of the law as a means of prediction is also fully discussed in Mr. Garrett's book, which we can heartily recommend everyone interested in chemistry to add to his library. References are given to the original publications, but it would be advantageous in a future edition to have these also collected into a bibliography at the end of the book.

## ZOOLOGY.

**Indian Insect Life;** A Manual of the Insects of the Plains (Tropical India), by H. Maxweil-Lefroy, assisted by F. M. Howlett; published under the authority of the Government of India (Calcutta and Simla: Thacker Spink and Co.; London: Thacker and Co., 1909; pp. xii. and 786).—The Indian Government is going very strong in the matter of entomological publications. It is publishing a detailed account of all the known Indian insects in the volumes of the "Fauna of British India," and it has sanctioned the issue of the handsome and lavishly illustrated volume now before us. To say nothing of the fact that the compilation of the "Fauna" will be a work of years, there is ample room for the two works, as Mr. Lefroy's volume treats the subject from an entirely different standpoint to the one followed in the larger work, dwelling to a great extent on its economic aspect. Moreover, it was of the utmost importance that there should be a standard work treating of this vast subject, so far as it can be adequately treated, within the compass of a single volume; for nowadays the vast importance of the study of entomology from the point of view of agriculture, horticulture, sanitation, and the checking of diseases is fully recognised in all tropical countries, but nowhere more so than in India, where a special division of the Department of Agriculture has been established for this purpose. Formerly the work of this section, of which Mr. Maxwell-Lefroy is chief, was carried on at the Indian Museum, Calcutta, but it now has a station of its own at Pusa, where the research staff of the Department of Agriculture has its headquarters. Needless to say that the author, who has relegated a few sections to his assistant, Mr. Howlett, has performed his task in a thoroughly admirable and workmanlike manner, so that with this volume to refer to a student of the subject ought to have no difficulty in referring any insect with which he may have to deal at least to its proper family group. The work, in addition to other figures, is lavishly illustrated with a very large number of coloured plates of insects and their larvæ, which reflect the highest possible credit on all concerned in their production. Indeed, the work may be said to mark an epoch in the history of colour-printing in India, for, according to the author, the beautiful plates, which were printed, under very trying climatic conditions, by the Calcutta Phototype Company, are the first of their kind ever issued in the country. With such a first effort, great things are evidently to be looked for from the Company in the future. The volume also contains a map illustrating the chief climatic and physically distinct districts of India. In connection with this, it may be mentioned that the native name of the great swamp-districts of lower Bengal is spelt Sundarbands on the map and Sundarbuns on page 25 of the text. In reviewing the importance of insects to the human race, the author observes that "with the exception of domestic animals there is no single group of animal life which enters more into the daily life of man than insects. They live on us and around us; in our food, our clothes, our furniture, our houses; we eat them or their products, we collect them and even sew them on our clothing. . . . Man is therefore dependent on the insect world for so much, and though science may devise substitutes for the products derived from insects, some of them at least will never replace the genuine thing. No artificial honey will ever compare with the honey gathered by bees; . . . no substitute for bees-wax has been found, nor for shellac." We have the greatest pleasure in offering our heartiest congratulations to the author and those who have aided in bringing out this splendid work; and we may likewise take the opportunity of recording our sense of the obligations which naturalists in all parts of the world owe to the Indian Government for authorising its publication.

## MISCELLANEOUS.

**Three Years in Tibet,** by Ekai Kawagughi, late Rector of Gohyakurakan Monastery, Japan (Benares and London: Theosophical Publishing Society; pp. 719, with photogravures, and map of author's route; 16s. net).—This is undoubtedly a remarkable work, and is of fascinating interest. The author is a Japanese Buddhist priest, and from a religious point of view alone the work is of great value. We may not admire his deceptions, nor his method of escaping from great danger by making his enemy drunk, and giving instructions that he should be kept so until the author had passed away on his journey out of danger. But geographers will find an immense fund of information here concerning Lhasa and the Tibetans, as well as topographical information of great value. Lamaism, the exclusive policy, punishment, marriage and wedding ceremonies, the warrior-priests, and various habits and customs are described with much detail, and the author has beaten all records in the information he has given to the world. We rather fear for the author's welfare if ever he sets foot in Tibet again. Our Foreign Office as well as other Government Offices would do well to stock the volume.

**Tommy's Adventures in Natureland,** by Sir Digby Pigott, C.B. (Witherby and Co.; pp. xvi. and 180, with illustrations by Alec Carruthers Gould and the author; 2s. 6d. net).—This little book is a sequel to the same author's "The Changeling," and recounts in language suitable for boys and girls, the further adventures of Tommy and Mollie. Much useful information is imparted to these youngsters, and in reading it to our own during the coming winter nights, when the homework is done and it is not yet bed-time, no doubt we shall live over again our own youthful delights and experiences.

## YEAR BOOKS.

**Who's Who, 1910** (A. and C. Black), 10s. net;
**Who's Who Year Book, 1910** (A. and C. Black), 1s. net;
**The Writer's and Artist's Year Book, 1910** (A. and C. Black), 1s. net;
**The Social Calendar for 1910** (A. and C. Black), 2s. 6d. net, by Mr. M. M. E. Adams and Miss E. A. Browne;
**The Englishwoman's Year Book** (A. and C. Black), 2s. 6d. net;
**Year Book of the Scientific and Learned Societies of Great Britain and Ireland** (Griffin and Co.), 7s. 6d.

From Messrs. A. and C. Black we have received the numerous publications, a list of which is given above, which become more indispensable year by year. "Who's Who," to take the first and largest of them, contains no fewer than 23,000 biographies and 2,200 pages. It is kept up-to-date and accurate by submitting every biography to the personal revision of its subject; and a more useful, a more capable, and, we may add, a more interesting production would be hard to find. Its autobiographies, for such they are in essentials, are compulsorily brief, but they are often self-revealing, and as a compilation "Who's Who" is a lexicon of achievements as well as an encyclopædia of personalities.

In their more restricted spheres, the shorter publications, such as the "Who's Who Year Book," which classifies in tables Ambassadors and Professors, Churches and Clubs, Law Officers and Hospitals, and a hundred other things which one can find so conveniently nowhere else; the "Englishwoman's Year Book"; the "Writer's and Artist's Year Book"; and the new "Social Calendar," are equally useful and indispensable.

Of the Year Book of the Scientific and Learned Societies, which is published by Messrs. Griffin, and now appears for the twenty-sixth time, it is necessary to say no more than that it is absolutely accurate and is full of contents to which every scientific man is of necessity bound to refer many times during the year. As a consecutive series, these Year Books of the Scientific and Learned Societies, recording as they do all the principal papers read, give a concise and complete summary of the progress of the sciences in the United Kingdom during a generation.

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# MICROSCOPY.

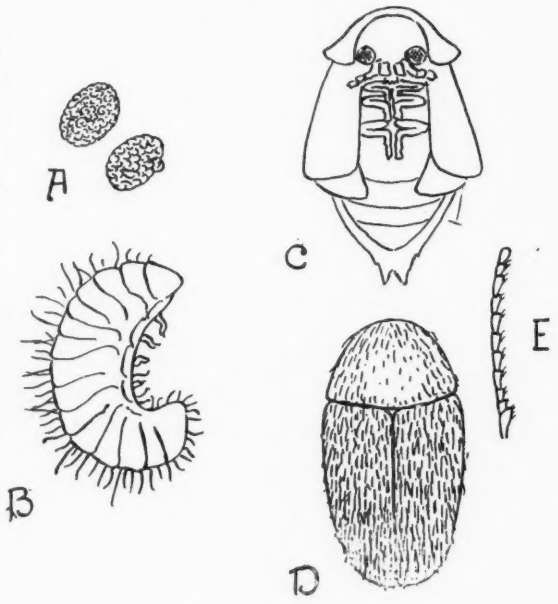
*Conducted by* F. SHILLINGTON SCALES, M.A., F.R.M.S.

## Beetles on Tobacco Leaf.

MR. J. P. WRIGHT, of Bristol, very kindly sent to me recently some slides of a beetle found in bales of Turkish tobacco, and has since been good enough to send me the eggs and the larval and pupal stages of the same beetle from the same source. He says, concerning these beetles, that Turkish tobacco leaf is imported in bales, fairly compressed, and that when an infested bale is opened few beetles are observed, but when the leaves are separated they soon make their appearance. Given an infested bale there is no difficulty in finding either the eggs or the beetle, but the larval and pupal stages are more difficult to discover. The metamorphosis of a beetle takes some time, which makes the difficulty of discovering the larval and pupal stages somewhat hard to explain. Mr. Wright says he has been told by an expert in the tobacco trade that the beetles "thrive merrily on naphthalene," and, as an experiment, some of the infested leaf was put in a box with a perforated false bottom, in which was placed some naphthalene, and so left for some time. When the box was opened it was found that the beetles had left the leaf and taken refuge in the naphthalene, from which, however, they flew in clouds as soon as the cover was removed. They are readily killed by bisulphide of carbon. According to Mr. Wright's information these beetles are peculiar to the Turkish growth, and are not found on Indian, African, Virginian, or China tobacco leaf, and only an occasional bale of this kind is infested.

I have shown these beetles to Mr. Cecil Warburton, of Cambridge, and he has suggested its probable identity with the "Cigarette Beetle" (*Lasioderma serricorne* Fab.), of which a description appears in a publication of the Entomological Division of the United States Department of Agriculture, published in 1896, entitled "The Principal Household Insects of the United States" by L. O. Howard and C. L: Marlatt, with a chapter on insects affecting dry vegetable foods, by F. H. Chittenden. The accompanying drawings give a rough sketch of the beetle sent me by Mr. J. P. Wright and correspond very closely to those illustrated in the above Bulletin. A represents the egg, B the larva, C the pupa, and D the beetle itself. In the specimens sent me the antennæ are short, as represented in Fig. C, whereas in Chittenden's drawings the beetle has many-jointed serrate antennæ as represented in Fig. E. The antennæ in the specimens sent to me, and illustrated herewith, have, evidently, been broken off, as Mr. Wright has since sent me specimens with 10 joints. The beetle is about one-eighth of an inch long.

According to Chittenden, the Cigarette Beetle closely resembles the well-known Drug Store Beetle (*Sitodrepa panicea* Linn.), one of the family Ptinidæ, both in superficial appearance and in having very similar habits. It is cylindrical in form, of a uniform light brown colour, with very fine silky pubescence, but is more robust in shape; the elytra are not striated, the head is more prominent, and the antennæ are nearly uniformly serrate instead of ending in a three-jointed club. When at rest the head is retracted into the peculiar hood-like thorax, and with the legs and antennæ folded under and tightly appressed to the body, the little creature easily escapes observation. The larva is white with darker mouth-parts, and of a cylindrical curved form, as indicated at B, and is more wrinkled and hairy than that of *Sitodrepa*, differing also somewhat in the structure of the head and legs. The pupa (Fig. C) is white and is encased, like other Ptinids, in a fragile cocoon. As its English name indicates, it is chiefly known as a destroyer of tobacco, and as such, according to Chittenden, should, in the opinion of many thinking people, be classified with beneficial insects! It is by no means so common as the Drug Store Beetle, but it is on the increase and doubtless will in time be found to have nearly the same range of food materials. As a tobacco feeder it outranks that species, and also appears to favour certain medicinal plants not so often affected by the *Sitodrepa*.




**Tobacco-leaf Beetle.**

A, Egg; B, Larva; C, Pupa; D, Beetle.

Of household supplies it has been found, both by Chittenden and others, infesting cayenne pepper, ginger, rhubarb, rice, figs, yeast cakes, and prepared fish food. It has been reported as destructive to silk and plush upholstery, and has done considerable damage to dried and preserved herbarium specimens in Washington. Of drugs it is partial to ergot and turmeric, and tobacco it devours in every form, in the leaf and when made up into chewing plug, cigarettes, and cigars.

Of the allied species *Sitodrepa*, Chittenden says that in powdery substances the larvæ form little round balls or cells, which become cocoons, in which they undergo transformation to pupæ and then to adult insects, and this may have some bearing upon a remark of Mr. Wright's that in one slide in his collection there appears to be a cocoon, but he mentions the possibility of this being formed by some other insect. Chittenden says he has reared *Sitodrepa* from egg to beetle in two months, and as it habitually lives in artificially heated buildings and breeds out

through the winter months, there may be at least four broods in a moderately warm atmosphere. Minute as is *Sitodrepa*, also, it is preyed upon by a still smaller parasite, a chalcis fly known as *Meraporus calandræ* How., which pursues its victim relentlessly, even entering insect boxes infested by its host. A diminutive mite, *Heteropus ventricosus* Newp., also preys upon this as well as many other species of like habits, attacking it in its larval and pupal condition.

NOTE.—Mr. Wright has been kind enough to send me seventeen slides of the eggs of this beetle and nine slides of the beetle itself ready mounted, and I shall be glad to send one of these (as far as the supply goes) to anyone who is really interested in the subject, but as there are so few specimens I cannot distribute them generally, and I hope ordinary readers will not apply. Will those who do so kindly send a box and postage?

### Mounting Amoebæ.

The mounting of Infusoria, and especially amoebæ, is a proceeding that is often attended by considerable disappointment, and on more than one occasion questions have been asked in these columns upon the subject. Recently I have seen some slides mounted by a process which seemed to give very good results. In response to a request the process has been kindly communicated to me by Mr. W. Llewellyn Jones, who mounted the slides referred to, and I give it here in the hope that others may obtain equally satisfactory results. Mr. Llewellyn Jones says that he first gets the specimens in clear water on to the slip by means of a pipette, and fixes with Picro-Formol (Bouin), prepared according to the following formula (see Lee, 6th ed., page 76):—

| | | | | | |
|---|---|---|---|---|---|
| Picric acid, sat. aqueous sol. | ... | ... | ... | 75 | parts |
| Formol | ... | ... | ... | 25 | „ |
| Acetic acid | ... | ... | ... | 5 | „ |

Wash out with alcohol.

The objects are then stained, dehydrated, &c. While in the alcohol (say, 50 per cent.), whether after or before staining, if the alcohol is carefully drained off with a pipette or blotting paper till there is only a film, so that the amoebæ are no longer floating but in contact with the slip, it will be found that they will usually adhere, and accordingly the subsequent operations may be carried out by simply allowing the liquids to flow gently over the slip.

There is some little knack required, as the specimen must not be allowed to get too dry or it will shrivel at once, and be in consequence spoiled. With a little practice three out of four slides can be counted on as good enough to keep.

Mr. Llewellyn Jones says he tried Penard's method of fixing with absolute alcohol and poking the specimen about with needles, but without any success as regards the amoebæ and other naked forms. He has also tried Meyer's albumen fixative and failed.

### The Late Dr. W. H. Dallinger, F.R.S.

Though the younger generation of microscopists knew little of Dr. Dallinger other than his name, his death on November 7th last has removed from us one of our foremost workers with the microscope, whose work in itself has been of no little importance, and whose influence has been of still more weight. William Henry Dallinger was born at Devonport on July 5th, 1840. His interest in natural science was early awakened, and at one time he had thoughts of becoming a medical man, but religious tendencies predominated, and he became a Wesleyan Methodist minister, his first circuit, in 1861, being that of Faversham, followed by those of Cardiff, Bristol, and Liverpool. Until 1880 he worked as an ordinary circuit minister, but his spare time was given to scientific study, and to acquiring a knowledge of Hebrew, Greek, and German. From 1880 to 1888 he was appointed Governor and Principal of Wesley College, Sheffield, but in the latter year he resigned and became a minister without pastoral charge, so that he might have time to carry on his scientific studies and researches, though he was always a welcome preacher in the various chapels of his denomination. To the public in general he soon became known as a popular scientific lecturer, especially in connection with the Gilchrist Trust, his felicitous presentation of the more interesting side of natural history, accompanied as his lectures were by beautiful lantern slides (many of them moving slides), always attracting large audiences. He also contributed for some time a series of interesting popular scientific articles to the "Wesleyan Methodist Magazine," and in 1896 published the well-known "Fernley Lecture" on "The Creator, and what we may know about Creation," as well as "Life Histories and their Lessons; a Defence of the Uniformity and Stability of Vital Processes as controlled by the Laws of Evolution." In 1891, and again in 1901, he was asked to revise and edit new editions of Carpenter's "The Microscope and its Revelations," the most authoritative book on the subject.

His original scientific work is almost entirely connected with the minute infusoria known as the Monads and with his investigations into their life history, and his researches on the subject are notable for the painstaking way in which he devoted himself for a long period to this investigation, and to the infinite care which he took to verify his results. At that time there was much discussion as to the origin of life, and more particularly as to the possibility of "spontaneous generation." Dr. Dallinger showed that many of the experiments on which reliance had been placed, as showing the spontaneous evolution of life, were due to a misapprehension as to the temperature which could be sustained by the lowly organisms referred to, and he formed the idea of endeavouring to modify certain infusoria according to their environment, and thus to see whether they could adapt themselves to a great change of temperature in the medium in which they lived. Starting with normal specimens of *Tetramitus rostratus* and two other forms, which live ordinarily at a temperature of 60° F., he gradually raised the temperature whilst continuing the cultivation. The adaptation of the infusoria was not carried out without difficulty, but was none the less completely successful, and Dr. Dallinger finally obtained infusoria which could live and flourish at a temperature of 158° F., which was immediately fatal to the original unaltered stock, whilst these modified organisms themselves could not live at the original temperature. This work, valuable in itself, secured for Dallinger recognition not only from scientific men, but from a wider public.

In 1880 Dr. Dallinger was made a Fellow of the Royal Society, and soon after received a grant of £100 to assist his researches. In 1884 Victoria University made him LL.D., in 1892 Dublin gave him its D.Sc., and in 1896 Durham gave him its D.C.L.

He was a Fellow of the Royal Microscopical Society from 1871 until the time of his death, and was President from 1884 to 1887, many of his most important results being communicated to the Society in his Presidential Addresses and in special papers. Subsequently, he became Joint Secretary, though latterly he took little part in the work of the Society, and was, indeed, scarcely known personally to more recent Fellows. But his in-

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terest in the Society was always keen, and when President he would generally travel back to Sheffield by the night train in order to be back at his work at Wesley College by next morning. In recent years, he unfortunately suffered from more than one severe attack of influenza, and latterly it was apparent to those who knew him that his strength was failing.

### New Vertical Illuminator.

Messrs. Ernst Leitz have recently introduced an improved form of vertical illuminator for illuminating opaque objects with high powers, and a new simple illuminator for low powers. The first of these is illustrated in fig. 1 herewith, and it will be seen that it consists of a small right angle prism which cuts partially across the field of view immediately above and as close as possible to the back lens of the objective. An aperture in the side of the short tube containing this prism admits a strong beam of light and reflects it down through the objective on to the object. Messrs. Leitz's improvements consist of a means of adjustment of the prism in respect to the optic axis of the microscope, and of rotating the whole fitting, and of the addition of a short tube containing an adjustable lens to focus the beam of illumination from the side.

Fig. 1

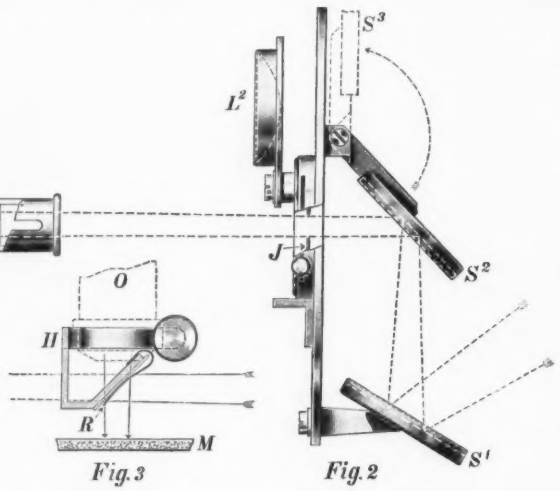


Fig. 2



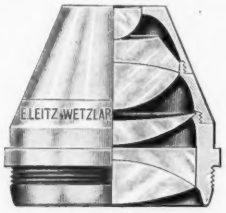
Fig. 3

The illuminator for low powers consists of a mica plate placed beneath the objective and at an angle of 45° to it, and supported by a clamping ring which fits on to the objective mount. The mica plate reflects a beam of light upon the object as shown in fig. 3.

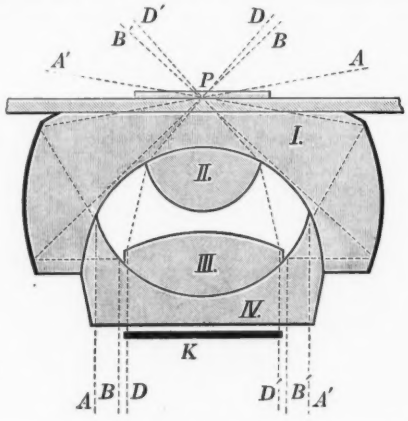
For use with both forms of illuminator a special stand has been devised to enable a horizontal beam of light to be readily thrown upon either piece of apparatus. A large plate is supported upon a stand, and this plate is adjustable vertically not only by means of a clamp but by an efficient fine adjustment. A movable mirror swinging in a gymbal reflects the light upwards to a mirror placed at an angle of 45° opposite to the aperture in the plate. The second mirror can be swung aside if required, as shown in fig. 2. The aperture is fitted with an iris diaphragm to adjust the amount of light, and with a condensing lens which is designed for use with the low power illuminator illustrated in fig. 3. With both forms of illuminator lenses with short mounts should be used, and as the objects must be uncovered, if glare is to be obviated, objectives corrected for use with uncovered objects are advisable.

### Two New Condensers.

Messrs. Ernst Leitz have also brought out two new condensers which are of interest for quite different reasons. The first is an achromatic oil-immersion condenser of 1·4 N.A. with an aplanatic cone of nearly the same amount. Its focal length is about $\frac{1}{3}$ of an inch, and its working distance is 1·2 millimetres, allowing the use of slides of this thickness. It can, of course, be used as a dry condenser of less than 1·0 N.A. The advantage of such a condenser with high-power and critical work and in photo-micrography has long been known to and preached by English microscopists, and the introduction of such condensers by leading Continental makers, instead of the hitherto almost universal uncorrected Abbe form of illuminator, is worthy of note as a sign of progress not less important than the recent improvements in Continental types of fine adjustment. It cannot be too often insisted upon that the perfect performance of the modern microscope objective is dependent upon scarcely less perfect means of illumination, and in such illumination the substage condenser plays a leading part. To use an apochromatic or semi-apochromatic objective with the ordinary Abbe illuminator, with all its errors of chromatic and spherical aberration, is to stultify the beautiful corrections of the objective.




The other condenser is an endeavour to combine in one piece of apparatus an ordinary condenser and a dark-ground illuminator (see "KNOWLEDGE" for October, 1909, pages 396-8). A reference to the accompanying sectional drawing will show that the central spot is removable, and that the central cavity in the condenser, whose sides are responsible for the reflections which give dark-ground illumination of high angle, contains two lenses. When the central spot is in position the condenser acts as a reflecting condenser for dark-ground



illumination with high powers, constructed according to Messrs. Leitz's usual formula; but when the spot is removed the two central lenses, hitherto obscured, come into play, and the apparatus becomes an ordinary condenser of 1·4 N.A., and can be used for transmitted light in the usual way.

### Royal Microscopical Society.

November 17. Mr. C. Beck exhibited and described a new form of speculum lamp, devised by Mr. J. W. Gordon, which was a modification of the lamp exhibited at the last meeting.

Mr. Edward Heron-Allen, F.R.M.S., F.L.S., read the fourth paper of the joint series by himself and Mr. Arthur Earland, dealing with the Foraminifera found in the Shore-Sands of Selsey Bill, Sussex. This instalment covered the genera Cycloloculina to Nummulites inclusive, and included many rare and interesting forms, but no new species. Of the genus Cycloloculina from this locality, first described by the authors in 1908, a few additional details were mentioned, but the original source of the specimens still remains doubtful, although its distribution has now been worked out over an extensive area of the Peninsula. The evidence, however, points to the Eocene Beds of Bracklesham Bay as the source from which the specimens were derived, although none have been found *in situ*.

The paper was admirably illustrated by a series of about ninety lantern slides, photographed from specimens specially mounted for the purpose, and by the following slides under microscopes: (1) Typical Foraminifera of Selsey Shore-Sand. (2) Common ditto. (3) Selected ditto. (4) Typical ditto. (5) *Cycloloculina annulata*. (6) *Pulvinulina vermiculata*, (7) *Polymorphina hirsuta*. (8) Nummulites. (9) *Polystomella striato-punctata* var. *selseyensis*. (10) *Rotalia calcar*. (11) *Pulvinulina concentrica*. (12) *Planorbulina eocenica* (?), a species awaiting determination. (13) *Discorbina semi-marginata*. (14) *Discorbina cristata*, sp. n. (15) *Spirillina selseyensis*, sp. n. (16) *Polymorphina complanata*. (17) *Lagena orbignyana* var. *selseyensis*.

In the subsequent description Mr. Spitta commented on the excellence of the photo-micrographs shown, which were the work of Mr. A. E. Smith, the lantern slides being prepared by Mr. J. A. Lovegrove. There was a difficulty in photographing such large and thick objects, as it was not possible to get them entirely in focus. The art of the photographer lay in deciding which plane it was best to have in focus, and after that how much depth of focus was permissible. If the iris diaphragm were closed too much for the latter purpose, all manner of diffraction phenomena presented themselves, and the resulting photograph showed all sorts of false images. Moreover the N.A. of the objective, and consequently its resolving power, was reduced, so that the minute structure of the object suffered. Therefore by attempting to gain too great depth of focus two evils were apt to result—the introduction of false details and the omission of fine details which really existed. On the other hand, if the iris diaphragm were closed too little, the object looked flat and uninteresting. Herein lay the skill and individuality of the operator.

### Quekett Microscopical Club.

November 23, 1909. The President, Professor E. A. Minchin, exhibited and described two preparations of the cysticercus stage of a tapeworm, from rat fleas. It was probably *Hymenolepis diminuta*. A new locality for *Zoothamnium geniculatum* was communicated by Mr. J. Stevens, F.R.M.S.

Mr. F. R. Smith contributed a "Note on the mounting of spider dissections as microscopical objects." Any attempt to "clear" a spider with alkali ruined it so far as systematic work was concerned. He used slips with excavated cells half-an-inch in diameter, and around the excavation cemented with gold size tin cells of varying thicknesses to suit different objects. The mounting medium employed was equal parts of whisky and glycerine. The spider, which had been killed in whisky, or such part as required, was placed in one of the cells and the latter filled up with whisky. A temporary cover glass is held in position with a weak wire-clip, and the preparation examined for movement. When a cell of proper depth has been so selected it is thoroughly cleaned and a ring of caoutchouc cement run on to the top of the tin cell. The mounting medium is run in, the dissection introduced and arranged and cover glass put on and held in position with a clip. To avoid the inrush of a bubble of air the clip should be removed under water, and the slide allowed to remain submerged for a few minutes. After wiping the mount dry, a ring of gold size is added, and a couple of days later a ring of club-black.

Mr. J. S. Dunkerly, B.Sc., gave "A *résumé* of our knowledge of the Choanoflagellata."

### Notes and Queries.

*W. H. (Belfast).*—The two plano-convex lenses of which you send me particulars are *much* too large to make a microscope ocular, as the resulting tube would be most unwieldy. The field lens of the ocular (the larger and lower lens in your sketch) really acts as part of the objective, collecting the rays of light and bringing them to a focus between the field lens and the eye-lens, where they can be magnified by the latter acting as a simple magnifying lens. As most objectives are constructed to focus 6 inches, or thereabouts, from their posterior lens, you will see the impracticability of using your suggested long-focus lenses. There are also other good reasons connected with the matter which I need not enter into here. There is no reason why you should not attempt to make yourself a microscope if you are accustomed to working in brass, but I would strongly recommend you to buy both ocular and objective. The former can be bought for 5s., the latter from 12s., upwards. With regard to the latter part of your question, an objective of $\frac{1}{8}$-inch focus would give an *initial* magnification (that is, not counting the eyepiece) in a 10-inch tube of about 80 linear diameters, a $\frac{1}{6}$-inch would give 60, and a $\frac{1}{4}$-inch 40. With a 6-inch tube the initial magnifications would be six-tenths of the above. To get the *combined* magnification with eyepiece, multiply the above by the magnifying power of whatever eyepiece you use. The objectives cannot be used together in combination—each one must be used by itself alone. I do not answer queries direct, except in special circumstances.

*J. B. W. (Exeter).*—I am sorry to say that I do not know of any more recent book dealing with British Lichens from the systematic point of view than Leighton's "Lichen-Flora of Great Britain," published in 1879, nor does there seem to be a more elementary work suitable for the less advanced worker. From the morphological point of view there are several text-books which deal with the subject more or less thoroughly, of which, perhaps, the most recent is J. P. Lotsy's "Vorträge über Botanische Stammesgeschichte," published in 1907 by Gustav Fischer, of Jena. This is a volume of over 800 pages dealing with general botany, but the portion devoted to Lichens is perhaps the most recent summary of our knowledge of the subject. The book is, of course, in German, and does not deal with the subject from the systematic standpoint. Strasburger's well-known "Text-Book of Botany" (English translation published by Macmillan) only devotes about half a dozen pages to the subject.

*C. A. M. (Weymouth).*—I do not think it is possible to keep Volvox alive for more than a few days, and I understand that material of this nature obtained for teaching purposes and study in the botany schools here cannot be kept longer. It would be interesting to know if any reader has succeeded better.

*[Communications and inquiries on Microscopical matters should be address to F. Shillington Scales, "Redcourt," Adams Road, Cambridg Correspondents are requested not to send specimens to be named.]*

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## The Face of the Sky for January.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 8.8 and sets at 3.59; on the 31st he rises at 7.43 and sets at 4.44. The Earth is nearest the Sun on the 1st, when the Sun attains his maximum apparent diameter of 32′ 35″. Sunspots and faculæ may usually be observed on the solar disc; of late there has been several fine groups of spots visible. The positions of the Sun's axis, centre of the disc, and heliographic longitude are given below:—

| Date. | Axis inclined from N. point. | Centre of Disc S. of Sun's Equator. | Heliographic Longitude of Centre of Disc. |
|---|---|---|---|
| Jan. 1 .. | 2° 8′E | 3° 8′ | 72° 4′ |
| ,, 6 .. | 0° 18′W | 3° 43′ | 6° 13′ |
| ,, 11 .. | 2° 43′W | 4° 15′ | 300° 22′ |
| ,, 21 .. | 7° 25′W | 5° 13′ | 168° 42′ |
| ,, 31 .. | 11° 46′W | 6° 1′ | 37° 2′ |

THE MOON:—

| Date. | Phases. | H. M. |
|---|---|---|
| Jan. 3.. | ☾ Last Quarter | 1 27 p.m. |
| ,, 11.. | ● New Moon | 11 51 a.m. |
| ,, 18.. | ☽ First Quarter | 10 21 a.m. |
| ,, 25.. | ○ Full Moon | 11 51 a.m. |

OCCULTATIONS.—The following are the principal occultations visible from Greenwich:—

| Date. | Star's Name. | Magnitude. | Disappearance. | | Reappearance. | |
|---|---|---|---|---|---|---|
| | | | Mean Time. | Angle from N. point, E. | Mean Time. | Angle from N. point, E. |
| | | | P.M. | | P.M. | |
| Jan. 17 | *f* Piscium .. | 5·3 | 6.47 | 37° | 7·52 | 258° |
| | | | A.M. | | A.M. | |
| ,, 21 | $\omega^2$ Tauri .. | 4·8 | 3. 3 | 88° | 3·53 | 253° |
| | | | P.M. | | P.M. | |
| ,, 23 | 37 Geminorum | 5·7 | 4·39 | 7° | 4·52 | 340° |

THE PLANETS.—Mercury (Jan. 1, R.A. 19h 56m; Dec. S. 22° 47′. Jan. 31, R.A. 20h 4m; Dec. S. 16° 46′) is an evening star in Sagittarius. On the 10th the planet is at greatest Easterly elongation of 19° and sets at 5.50 p.m. or 1h 40m after the Sun; the elongation is thus somewhat favourable for observing this elusive planet, but the opportunity lasts only a few days, since Mercury is in inferior conjunction with the Sun on the 26th.

Venus (Jan. 1, R.A. 21h 42m; Dec. S. 13° 55′. Jan. 31, R.A. 21h 57m; Dec. S. 5° 53′) is a brilliant object in the South-West portion of the sky shortly after sunset. The planet is at *greatest brilliancy* on the 7th, when the telescopic appearance is a thin crescent, the diameter of the disc being 41″, of which 0·27 is illuminated. On the 1st the planet sets at 7.52 p.m. and on the 31st at 6.51 p.m. On clear days about the period of greatest brilliancy the planet may be discerned in broad day-light especially at this time of the year when the Sun is not so glaring. Venus is a severe test object for most telescopes, and even in the best refractors the absence of perfect achromatism is noticeable.

Mars (Jan. 1, R.A. 1h 6m; Dec. N. 7° 33′. Jan. 31, R.A. 2h 9m; Dec. N. 14° 3′) is visible until after midnight but is rapidly diminishing in brightness, as its distance from the Earth increases. The apparent diameter of the planet has decreased to 8″ compared with 24″ at opposition, and telescopic observations are correspondingly more difficult. On the 1st the planet is in conjunction with Saturn, Mars being about 3° to the North; the two planets form a conspicuous object and exhibit a striking contrast in colour, they are due South at 6.25 p.m. The Southern hemisphere of the planet is inclined towards the Earth, but the Polar Snow Cap has dwindled, in the Martian Summer, to inconspicuous dimensions. The planet is in quadrature on the 18th.

Jupiter (Jan. 1, R.A. 12h 51m; Dec. S. 4° 3′. Jan. 31, R.A. 12h 56m; Dec. S. 4° 25′) rises about midnight on the 1st and about 10 p.m. on the 31st. The planet with his bright moons and dark equatorial belts and spots is an interesting object even in small telescopes. He is in quadrature on the 4th, and at the stationary point on the 30th. The equatorial diameter of the planet is 36″, whilst the polar diameter is 2″·3 smaller. This polar flattening is readily observed in telescopes powerful enough to see the belts, but the satellites may be seen in small telescopes such as deer-stalkers of about 1¼ inches aperture, or even in a good pair of prismatic binoculars magnifying 8 times. The Moon appears near the planet on the 30th.

Saturn (Jan. 1, R.A. 1h 5m; Dec. N. 4° 9′. Jan. 31, R.A. 1h 10m; Dec. N. 4° 50′) is due South at 6.23 p.m. and in conjunction with Mars on the 1st. As seen in the telescope the ring appears fairly open, since we are looking on the Southern surface at an angle of 10°. The apparent diameters of the outer major and minor axes of the ring are respectively 41″ and 8″, whilst the diameter of the ball is 16″. The ring may be seen quite well in telescopes of about 1½ inches aperture with a magnifying power of 40, if the instrument is sufficiently steady and the object glass good; but larger telescopes are required to see the division in the ring and the belts on the disc. The planet is in quadrature on the 7th, and sets at 11 p.m. on the 31st.

Uranus (Jan. 16, R.A. 19h 33m; Dec. S. 22° 11′) is in conjunction with the Sun on the 12th, and hence is unobservable.

Neptune (Jan. 16, R.A. 7h 16m; Dec. N. 21° 34′) is in opposition to the Sun on the 9th, and hence about this date is on the meridian at midnight. The planet is situated in Gemini, about one degree South-East of the star $\delta$ Geminorum, but he is difficult to identify except in large telescopes. He may, however, be detected by his relative motion if successive observations are made at intervals of some days.

METEOR SHOWERS:—

| Date. | Radiant. | | Name. |
|---|---|---|---|
| | R.A. | Dec. | |
| | h. m. | | |
| Jan. 2-3 .. | XV. 20 | +53° | Quadrantids. |
| ,, 17 .. | XIX. 40 | +53° | $\theta$ Cygnids. |

Minima of Algol occur on the 2nd at 11.10 p.m., 5th at 7.59 p.m., 25th at 9.42 p.m., and 28th at 6.31 p.m.

TELESCOPIC OBJECTS:—

Nebulæ.—Orion Nebula, situated in the sword of Orion, and surrounding the multiple star $\theta$, is the finest of all nebulæ; with a 3 or 4 inch telescope it is best observed when low powers are employed.

Double Stars.—$\beta$ Orionis (Rigel), mags. 1 and 9, separation 9″. On account of the brightness of the principal star, this double is a fair test for a good object-glass of about 3-inch aperture.

Orionis, mags. 2 and 7, separation 53″; easy double.

$\lambda$ Orionis, mags. 4 and 6, separation 4″·5; pretty double.

$\sigma$ Orionis, triple, mags. 4, 8, and 7, separation 12″·5 and 42″.

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